Science Education

WHY NOT TEACH SCIENCE SCIENTIFICALLY? *

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This is a scientific age. The proceedings of scientific associations are now front page news. Inventions and discoveries are reported and published with the same avidity as interviews with foreign dictators, or details of scandals and accidents. Our means of transportation and communication, and hundreds of devices for home and business utility, comfort, and health, are direct or indirect resultants of the modern march of science.

Yet science in its essence does not consist of any of these things. It is rather a point-of-view, an attitude, a method. This "scientific point-of-view", this attitude of "unbiased judgment", this method of "intellectual honesty", is close to being the very cornerstone of democracy, because it is through scientific thinking that democracy can be saved.

Robert A. Millikan feels "the supreme question for all mankind is how it can best stimulate the application of the scientific method to all departments of human living." John L. Tildsley, former Assistant Superintendent of Schools in New York City, in charge of instruction in high schools, stated in one of his annual reports the primary objective for secondary schools "to develop in pupils an appreciation for the scientific method of thinking, and the habit of applying this method to other than strictly scientific matter." Alfred Whitehead refers to the scientific attitude as the most significant thing that has ever happened to the human race.

What do we mean by the "scientific attitude"? May I approach this by asking a few questions? What changes would be produced in individuals and hence in society if the following courses of actions were generally adopted? First, suppose that all people told the truth. Suppose we had only truthful statements from salesmen, clerks, advertisers, solicitors, travel agents, automobile mechanics, not to speak of dictators, politicians, husbands and wives! Second, what would it do for the training and development of judgment-forming capacity, if everyone insisted upon sufficient data before making positive statements, used more than imagination to get the other fellow's view point, and then worked toward a real solution of the problem? Third, what sound reactions would result, if instead of being swayed by personal desires, whims, fears, beliefs and superstitions, men proceeded honestly, without fear or favor to form their own dispassionate conclusions? Fourth, what freedom and release, with what impetus to creativity would follow, if trust and cooperation took the place of proscription and rule by authority? Under such conditions would not individuals and nations work out projects of living and creating, each untrammeled, expressing complete individuality without interfering with the rights of others?

Am I painting a Utopia? I am merely expanding Millikan's statement into my own expression of the significance of science in our world. Is not this interpretation of the scientific attitude practically synonymous with the ideals of democracy? True science can flourish only where institutions are democratic. Science and art never can be subsidized to the state without being imperiled. Both science and democracy are assailed today as never before. Conversely, there are inescapable respon-

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sibilities, especially for science teachers, in so teaching science that democracy will be strengthened by the straight thinking of those who go out every year from our schools and colleges.

The home and the school are the two great constructive agencies in childhood and adolescence. It is an accepted fact that the average home today does far too little for the future citizens of its own fold. The kind and value of home training vary enormously in different localities, but in general, sound preparation for life is neither accepted nor fulfilled by the home. We must then look to the school. Apparently, school men have for years, in theory at least, considered the classroom as the corner stone of training for democracy and life. Read their educational objectives in any book on education. Whether it is Dewey or O'Shea or Douglas or Monroe we shall find the same fundamentals differently expressed. Perhaps the list given in the report of the N.E.A. committee on the Reorganization of Science in 1920, largely a restatement of Herbert Spencer's doctrines, is as vital as when first made:

1. Health
2. Command of the fundamental processes
3. Worthy home membership
4. Citizenship
5. Worthy use of leisure
6. Vocation
7. Ethical character

The *Thirty-First Yearbook* of the National Society for the Study of Education emphasizes the need for the study of grouped concepts or "big ideas" rather than many scattered percepts, and also that training for thinking should begin much earlier than at present.

No current science text expects to succeed without including material leading to the inculcation of the scientific method. Within the year, I have seen pages from the manuscript of a laboratory manual based almost exclusively on the use of scientific procedure in laboratory work. Several large publishing houses are stressing the development of scientific thinking by the use of their texts. Perhaps at last we shall give science a real opportunity to make good in our class rooms and laboratories.

It is not so much a question of science teachers not wanting to spread the gospel of scientific method or scientific attitude, I think, as feeling under the thumb of fate. There are all sorts of examination hurdles to be taken, scholarships lie at the end of competitive tests for which intensive preparation must be made, and the curricular demands of supervisors, and of school or college, must be met. This combination of lesser demands becomes an insistent drive on the teacher to teach factually. Information, or its lack, can so easily be checked up. It is something definite and tangible.

I shall never forget seeing a class of men with a cross-eyed and terribly nearsighted teacher all sitting cross-legged on the floor in one of the open-air courts of the University of Elhazzar in Cairo. What did it matter that the teacher was myopic? They were learning the Koran just as it had been written a thousand years ago. For all they cared, the earth was flat and the sun moved around it.

Informative teaching wherever practised is only a modern version of the Mohammedan method of learning the Koran, or the Chinese program of committing to memory long statements of Confucius.

If I make this a little more concrete, we can study the problem together and consider some suggestions. Let us take Mr. Everyman, a teacher of science, who has been presenting a lesson on air to a general science class. Should he be satisfied with the presentation of the subject, chiefly by himself as demonstrator, the experiment to be written up in notebooks at home by the pupils? Is this experimental approach calculated to develop an appreciation of the scientific method? To a degree "yes". The work is empiric and experiential for the young observers. Yet in order to develop the possibilities for scientific atti-

tudes let me suggest a procedure which I believe is more constructive.

(1) In technique and methodology introduce only as many directions as may be essential. Try the plan of letting the experimental procedure develop as a result of democratic consideration of the problem and its possible solutions by the members of the class, instead of having all the directions come from the teacher. The extra time spent may have to be compensated for by the omission of a few experiments later, but it will begin to bear early fruit in the growing capacity of the class to meet problems and solve them. One of our greatest difficulties is the prearranged character of a science lesson, instead of a lesson which grows and develops. In recitations, questions involving "why" and "how" should predominate over "what" and "when".

(2) Have pupil assistants or even pupil demonstrators, wherever possible, rotating equably this opportunity for first-hand manipulation of apparatus. Do not direct everything the pupil does or he loses the sense of personal achievement.

(3) Make sure that pupils are never told, in advance, reactions or conclusions, either orally, on the blackboard, or by means of mimeographed sheets, nor even by an assigned lesson in the textbook. The experiment loses much of its dramatic appeal and its relation to research and the scientific mind, if it is used as an aftermath to the textual assignment where it becomes only a sort of post mortem illustration. Instead, so far as possible, let the lesson assignment follow the demonstration and classroom discussion as an outgrowth of the class activity. It will produce more scientific results if the teacher does not promptly accept the first correct answer and then move on to the next step without finding out to what extent the other pupils have reached the same correct conclusion.

(4) A good science teacher will never be guilty of dictating work nor of having pupils copy paragraphs from the text or drawings.

(5) To broaden the mental horizons of the young scientists in the class, the teacher may assign topics for further readings, for reports, a class discussion or socialized recitation, or current events in science. Knowledge which includes a familiarity with the scientific methodology of other experimenters builds scientific interest and makes for mental growth.

(6) Even drawings have a moral value. Many pupils at the start think that telling the truth is entirely an oral performance. They should be taught to tell the truth with the pencil. Slovenly work, careless outlines, and inattention to detail should disappear, not because of the disfavor of the teacher but through the changed attitude of the pupil toward truth-telling.

(7) In developing tests to cover experiments, limit recall ability to fundamentals, but add questions within the ability of the pupils, involving deductive application. If memory and information alone are called for, the mind becomes lazy and indifferent to real thinking.

(8) If the teacher is expert in developing the scientific attitude, it will not be a teacher-dominated class. The teacher will direct and guide the general procedure but will not be the head of all the activity. Class and teacher will be marching together toward a goal.

(9) The scientifically-minded teacher will make sure that economic generalizations and applications for personal living are obtained from each lesson, always from the pupils wherever possible.

(10) There are bound to be valuable projects and experiments allied to the classroom procedure for which no time can be taken in class. Here is a grand chance to enlist the assistance of members of one of the science clubs if there are such in the school. Representatives, after doing pupil-research work, can make reports in class, some times with demonstrations. (This is not theoretical procedure. Junior Science Clubs have become prominent in New York City schools, especially through the work of the American Institute of New York. For ten years, the American Institute has been an inspiring instrumentality in this city and vicinity in stimulating the formation and work of science clubs, workshop courses, zone meetings, an annual Science Congress, the amazing Junior Science Fair, and during the past year, a monthly magazine by and for pupils, *The Amateur Scientist*.)

(11) A scientifically-minded teacher will express friendly insistence. The word "friendly" excludes egotism, super-authority and autocracy. The word "insistence" insures against being "soft" and permitting pupils to get away with things, cut corners, and degenerate into a state of inactivity.

Nicholas Murray Butler, President of Columbia University in his report for 1927 says:

"The scientific method is everywhere extolled and within certain limits is rigorously applied. Yet the public mind, reinforced each year by a veritable army of youth which is marched through scientific laboratories and lecture rooms, museums and observatories, is as untouched by scientific methods as if no such thing existed."

Most of us feel that President Butler assumes a great deal in stating that the "scientific method is rigorously applied" anywhere. It is still a new or novel point-of-view. Too many of us have been too factually-minded from our own training and from habits of teaching under the long shadows of approaching examinations to have much faith in any method other than

textual questions and textual answers. The work of the daring few who set out to have pupils gain power to think has been neutralized by unscientific methods in other classes, and by contacts outside of the school. We are all of us immersed in a sea of unscientific actions and reactions. A single trip in a trolley or subway car will yield example after example of half-truths, lurid exaggerations, mis-statements, and alarm notes. Almost every radio program, no matter of how high a grade, is "siamesed" to wheedling expostulations based for the most part on nothing but vocabulary and a selected voice. Many advertisements in newspapers and magazines could not stand investigation. Politics is admittedly honeycombed with all sorts of graft, with a slimy trail through city after city up to the government itself. And war is the greatest madness of all.

Yet untoward environment for adolescents need not cause us to weaken. If "straight thinking" can ever be developed in school children, science is the subject, *par excellence,* for the purpose. Let the scientific method have a fair and broad-gauge trial. "To cause the scientific method to become a part of the bone and sinew of the boys and girls who throng our high schools so as to influence their manifold activities throughout their lives would be to create within a few generations a new moral and intellectual world."

Henry Suzzalo, when President of the University of Washington said:

> "The classroom dedicated to science should carry two standards side by side—freedom to think and no freedom to think slovenly or dishonestly. This is real intellectual liberty—freedom to think under logical law, much like political liberty, freedom to do as you please so long as law is obeyed. . . . In this way the stock of new and old truth, which is the final basis of human agreement in any cooperation whether it be a democracy or a business, will be guaranteed."

Just what are our basic aims? The question boils down to what we science teachers fundamentally want to accomplish. The acquisition of a working knowledge of the fundamentals is a goal worthy of our best efforts. But if it stops there we are in the group of science teachers who put all the emphasis on information. Are there citizenship values in mere facts? There may seem to be, but considered from a long range standpoint, there are likely to be few or none. A point-of-view might possibly be established but it is rarely sincere or valuable unless forged in the furnace of genuine thinking and living. Memory plays small part in science as a way of life.

Real education means something different from the stock in trade of the classroom dealing only in information. Are the mere facts of mathematics or history, however well rehearsed, capable of changing the lives of a certain number of the older members of our school population who, it is well known, will constitute the majority of the criminals during the period of the first five years after they leave school? Any prophylactic means that will save these youths must be tied up with an understanding of cause and effect, a willingness to participate in the experiment of democracy and a constructive conviction about the organization of society, namely that the health of the whole depends upon the wholeness of the parts. I am not saying that there are any human means at hand that will save adolescents bent on mischief or worse. But if anything can do it, the inculcation of sound attitudes is our white hope.

In a school of 1,000 pupils, forty-five, according to present statistics, will, at some time in life, be sent to an institution for mental disease. Is there any teacher here who thinks that a mere knowledge of human anatomy and particularly of the nervous system, however accurate, will save any of these unfortunates? The schools must face their responsibilities for developing poised and happy lives, with the right attitudes towards themselves and others. This can be done easiest when complexes and erroneous slants at life are small and uncrystallized.

Alexis Carel in his recent book: *Man, the Unknown,* says:

"The education dispensed by schools and universities consists chiefly in a training of the memory and of the muscles, in certain social manners, in a worship of athletics. Are such disciplines really suitable for modern men who need, above all other things, mental equilibrium, nervous stability, sound judgment, audacity, moral courage, and endurance?"

If you believe in the constructive products possible from science teaching, there are several things you can do.

1. Appraise yourself, checking for scientific methodology and possible unscientific practices.
2. Resist unscientific procedure in your environment, quietly and diplomatically but firmly.
3. Get committees appointed to overhaul syllabi, rebuilding these to develop "scientific thinking".
4. Discuss this subject of teaching for scientific attitudes informally with others, also in formal department or staff meetings. In this connection may I refer briefly to what the Scientific Council of New York City did under my chairmanship, last year.

In 1928 Jesse Whitsit, then Head of the Chemistry Department of DeWitt Clinton High School in New York City, and Chairman of the Science Council, published in the *Bulletin of High Points* an article that I still regard as the best presentation of methodology and techniques for teaching scientific thinking.

In 1932, there appeared the *Thirty-First Yearbook* of the National Society for the Study of Education enunciating broad generalizations of scientific ideas for science teachers. The development of attitudes was presented as an important by-product of science instruction.

This last May, the Science Council of the City of New York prepared and sent out to every science teacher in the high schools of the city, a long bulletin giving case situations in science teaching, both true and hypothetical. These cases were grouped under the respective sciences and searching questions, without answers, added in the hope that the material would be discussed by teachers both individually and in department meetings.

This bulletin was followed by the reissuance of "Science and Intellectual Integrity", the article by Mr. Whitsit to which I have just referred. Other bulletins exemplifying the teaching of attitudes and the inculcation of the scientific point of view are being planned by the Science Council.

This depression has literally forced educators to modify curricula and methods to meet the needs of the times. We are realizing that we must give training in thinking that makes for practice in solving problems and produces real mental growth. We must develop attitudes on the part of our pupils, through scientific procedure that will catch their interest, give them logical bases for action and help them to play the man when the time comes.

I shall close with a striking quotation from John Dewey,

"One of the only two articles that remain in my creed of life is that the future of our civilization depends upon the widening spread and deepening hold of the scientific habit of mind; and that the problem of problems in our education is therefore to discover how to mature and make effective this scientific habit. Mankind so far has been ruled by things and by words, not by thought, for till the last few moments of history, humanity has not been in possession of the conditions of secure and effective thinking.

Scientific method is not just a method which it has been found profitable to pursue in this or that abstruse subject for purely technical reasons. It represents the only method of thinking that has proved fruitful in any subject—that is what we mean when we call it scientific. It is not a peculiar development of thinking for highly specialized ends; it is thinking, so far as thought has become conscious of its proper ends and of the equipment indispensable for success in their pursuit.

If ever we are to be governed by intelligence, not by things and by words, science must have something to say about what we do, and not merely about how we may do it most easily and economically. And if this consummation is achieved, the transformation must occur through education, by bringing home to men's habitual inclination and attitude the significance of genuine knowledge and the full import of the conditions requisite for its attainment."

VISUAL AIDS FOR GENERAL SCIENCE CLASSES

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A great wealth of visual aids is available for the use of teachers of general science. Some of these instructional materials may be used by teachers in any locality, whether in the most poorly equipped school, or in the large city system where much thought and money are expended upon these materials which tend to make the experiences of the classroom more concrete.

A rather broad definition of visual aids is given in a recent text, *Visualizing the Curriculum*.[1] The authors define a visual aid as "any picture, model, object, or device which provides concrete visual experience to the learner for the purpose of (1) introducing, building up, enriching, or clarifying abstract concepts, (2) developing desirable attitudes, and (3) stimulating further activity on the part of the learner."

The various kinds of visual aids may be classified under six main headings: (1) the school journey, (2) museum material, (3) graphic materials, (4) demonstrations and dramatizations, (5) still figures, (6) motion pictures. This classification which begins with the simplest, and often the most easily available of the visual aids, the school journey, concludes with the most complex of all the forms of visual instruction, the motion picture.

THE SCHOOL JOURNEY

The excursion, field trip, or school journey should be a definite part of all science teaching. As with laboratory work, excursions need to be closely coordinated with the activities of the classroom, and are effective only when they serve to answer questions which cannot be answered elsewhere. They are sometimes most useful when they are used to introduce a unit of subject matter, and again they provide a valuable summary to a completed unit of work.

The teacher in a rural school or in a small community will find many worthwhile objectives for an excursion within a short distance of the school. Land formations, rocks and minerals, spring wild flowers, common weeds, native trees and shrubs, the homes of birds are some of the subjects that may be easily enriched through the school journey, especially in the rural schools.

Pupils in larger towns and cities benefit from trips to the local weather bureau, to a modern dairy, to an ice plant, to a gas plant, to the laboratory of the public health department, to parks, zoos, and botanical gardens.

The school journey has become a definite part of the teaching procedure in many European schools. These excursions may consist of a brief trip to some nearby point of interest, or of a journey that requires several days. Some courageous teachers and administrators in the United States have successfully conducted trips of several days duration in order that their pupils might experience the thrill of the Carlsbad Caverns, or some other natural or man-made scientific wonder.

Whether the school journey lasts for an hour or a day, it will not be successful unless it is preceded by adequate planning on the part of teacher and pupils, and is evaluated by some form of follow-up work such as reports and class discussions. Valuable suggestions for a variety of excursions is found in a publication of the Department of Public Instruction, Harrisburg, Penna.[2]

[1] Hoban, Charles F., Hoban, Charles F., Jr., Zisman, Samuel B. *Visualizing the Curriculum*. New York: The Cordon Co., 1937. p. 9.

[2] Educational Monographs. Vol. I, No. 6, *Visual Education and The School Journal*. Department of Public Instruction, Harrisburg, Pa., 1930. p. 18.

MUSEUM MATERIALS

A school is indeed fortunate that has a small room available, either connected with or near the science department, which can be used as a school museum. The collecting instinct is especially strong during the junior-high-school years, and all experienced teachers know that a variety of museum material is brought into the classroom by the boys and girls. Many a life-long hobby has been developed because of interests which were aroused while a boy or girl was in a science class. A museum of some sort, simple though it may be, should be provided to house these pupil-made collections.

The science museum, whether housed in a room of its own or scattered about the science room in cases and on shelves, will grow like mushrooms after a spring rain. The Nature Museum in the Yosemite National Park, which was begun in a small way, a few years ago, now boasts a building of its own and has exhibits from the Sierra Nevada Mountains which are of inestimable value. There, any day in summer one may see groups of Boy Scouts making use of the exhibit material. This museum's greatest value, however, is derived from the fact that the museum idea has spread from it throughout our National Parks. Similarly, the individual school may foster ideas and interests in its pupils which will be far reaching and enduring.

Commercial exhibits may be purchased as a part of the teaching museum, but specimens of local interest should predominate. In a mountainous region, specimens of rocks and minerals are naturally collected. Children who live along the seacoast will collect shells and seaweeds. Children of the East and Middle West are often made familiar with the trees, native stones, and wild flowers of their localities through well-prepared and attractively displayed exhibits. Local city museums will sometimes donate their surplus of specimens to school museums.

If the Science Club can be led to assume responsibility for the museum collections, the teacher's burden is made lighter. One science club in Ohio exchanged specimens with a club in California. The California club contributed fossils, seashells, a trap-door spider's nest, and certain exotic plants; the Ohio club supplied native plants and insects of the region.

In some instances classes or science clubs have collected material which is illustrative of the different manufacturing concerns of the region. In the East, the silk, woolen, and cotton mills offer some splendid exhibit material. Letters to these concerns usually elicit courteous replies, especially when the letters are written on stationary bearing the school letterhead.

The school museum need not be arranged and the specimens scientifically named as in the large city museums. However, some plan must be adhered to, or the result will be a chaotic mass of specimens having no particular value. Great interest will be aroused by having a supply of printed acquisition cards on which may be written the donor's name, date, locality where the specimen was found, common name, and scientific name. The purpose of the school museum is to interest and familiarize boys and girls with the scientific aspects of their own environment. Every locality has some outstanding feature of scientific interest. This factor should be capitalized by the alert science teacher.

Rare plant and insect specimens should be protected from air and common insect pests. This is frequently done by placing them in a Riker mount. Pupils can learn to make their own Riker mounts by fitting a piece of glass or cellophane into the lid of a box. When the box is filled with cotton and a few crystals of some insecticide such as naphthalein are added, a moth, butterfly, or interesting plant specimen is well protected from the air and insect pests. If cellophane is used, it must be left free at the edges so as not to wrinkle and pull loose. Insect collections may be safely

stored in cigar boxes lined with corrugated cardboard. In this way the specimens will be protected against the common insect pests, and no insecticide will be necessary. A supply of specimen jars and bottles is necessary in order that such specimens as snakes, fish, fleshy fungi, and other material of like nature may be preserved, either in formalin or alcohol.

Trays with small compartments form an excellent means of caring for rock, mineral, and fossil collections. They can be easily made by boys who are handy with tools. The pupils themselves will devise many ways of preserving and displaying exhibit material. In some schools museum cases are placed in wide corridors near the science classrooms. These cases are not wide; but with adequate shelving, they provide a means of displaying museum material to all who pass that way.

The uses of exhibit material are various. When introducing a new subject, a specimen will arouse interest as pictures can never do. Perhaps we may supplement Agassiz's famous command, "Study nature, not books" by "Use museum material, not pictures alone". Aside from kindling interest, such material will help to clear up misunderstood ideas as nothing else can do. Then for the purposes of review, specimens and exhibits have a real use. The identification test is a common exercise. Bird skins, minerals, mounted plants and leaves, and parts of dissectible models may be numbered and the class asked to name them. Because of their permanence, exhibit materials are relatively inexpensive. Every school should add new and worthwhile subjects each year.

Birds and small rodents are so elusive that it is difficult to observe them in the field. Their rapid movements quickly carry them away from us. If it is deemed advisable, much valuable material may be had by preserving the skins of birds and small animals. Many boys are quite skillful in preparing such material, and teachers will find helpful suggestions in two Guide Leaflets published by the American Museum of Natural History.[3] These study skins become important additions to the teaching museum.

GRAPHIC MATERIALS

In certain phases of science teaching, maps, globes, models, charts, cartoons and graphs are indispensable to a proper unfolding of the story of modern science. Although not always in daily use, when they are wanted the need is usually urgent and immediate. They are as necessary in the well-equipped laboratory or classroom as dictionaries and other reference material, and should be as freely and generously provided.

When children reach the junior and senior high schools they are expected to know the various political divisions of Europe and Asia, as well as the localities of the various states within our own United States. But expectations and realizations do not always agree, and it is advisable to have large maps of the United States, Europe, and Asia mounted on rollers and hung at a convenient level in General Science classrooms. Furthermore, many questions demand a knowledge of detail that cannot reasonably be assumed.

In the most elementary work in meteorology, the map must be used if boys and girls are to acquire clear ideas of isobars, isotherms, and the other symbols used in the making of the daily weather map of the sort which is published for most parts of the world. For this purpose a large blackboard outline map of at least the United States is valuable. On it the teacher may copy from day to day the highs and lows which are shown on the daily weather map, and trace their movement eastward. The outline map of note-

[3] Anthony, H. E. *The Capture and Preservation of Small Mammals for Study.* Guide Leaflet No. 61, New York: American Museum of Natural Hisory, 1925.

Chapin, James P. *The Preparation of Birds for Study.* Guide Leaflet No. 58, New York: American Museum of Natural History, 1929.

book size of the United States, as well as of the individual states, is likewise valuable. Weather maps may be constructed, using data that is supplied by the teacher.

Outline maps, both of blackboard and notebook size, are useful in many botanical and zoological studies, especially in those relating to the ecological distribution of plants and animals. They are also useful in problems relating to forestry, the location of state and national parks, and to similar questions pertaining to conservation.

The graphic relief map mounted on rollers is a valuable addition to the General Science equipment. The relief features are brought out very distinctly, giving almost the same effect as the heavier, actual relief map done in plaster of Paris.

The globe, which after all is a three-dimension map of the world, is a necessary piece of equipment in a science classroom in the junior high school. Hanging continually before the pupils, it gives clear conceptions of the earth: its shape, rotation, inclination, and the distribution of land and water areas. The globe is particularly helpful when it is a part of an instrument called a planetarium. This apparatus gives clear conceptions of the earth's rotation and revolution, the relation of the earth to the other planets in the solar system, and the causes of eclipses and tides.

A wealth of material is found among the models offered by several biological supply companies. These models are rather expensive, but if a program of enriching the science equipment each year similar to the annual enrichment plan for the library is followed, a school will acquire a good collection of these visual aids in a few years. When not in use, these models can very properly be placed in the school museum. Lessons on digestion and respiration take on a new interest and become fascinating subjects when a dissectible model of a human torso is available. The story of photosynthesis is easily understood if a model of a leaf showing stomata and surrounding cell structures, and a second model of a root with its root-hairs can be shown. Dissectible models of the ear and the eye, simple models of amoeba and paramecium, of cell division, and of other subjects that tend to be abstruse, are valuable aims in helping to make subject matter concrete.

Any science teacher who wants charts to illustrate her work can have an adequate supply of them. Lack of funds, an unsympathetic principal or superintendent will not deter, for charts can be made by teachers and pupils.

Science teaching often fails because it is not sufficiently concrete. Laws and principals are necessarily abstract, and the adolescent boy and girl cannot cope with them without the benefit of visual aids. Charts, as a means of rendering generalizations concrete, have at least three well-defined uses. First, they may supplement, even take the place of the text for a time, and in this way be a direct means of giving new information. Second, they are valuable helps in staging review lessons. Third, their construction frequently provides an excellent type of pupil activity.

Charts showing the various kinds of foods may be made from pictures cut from the advertisements in various magazines. Pupils must be cautioned against cutting pictures from books and magazines which should be preserved, or which belong to libraries, either public, school, or private. A suitable heading is as necessary for a chart or poster as a title is for a composition or an essay. "Proteins," "Vitamin A," and "A Well-Balanced Dinner" are suggestive.

Charts showing the different kinds of simple machines may also be made from the illustrations cut from magazines.

Charts that can be used semester after semester may be made to illustrate almost any law or principle, whether it is physical or biological. Diagrams and illustrations appearing in books and magazines may be made into permanent charts with India ink

or Vellum de Lux, a chart-making cloth.[4]

The blackboard has great possibilities as a medium for chart making. It is perhaps more serviceable in science teaching than in any other subject in the curriculum. There are many occasions when a diagram must be placed on the board, for example, in order to make clear the set-up of an experiment.

The author does not advocate so-called artistic drawings for science work, but all drawings should be large, clear, and well lettered.[5] Many excellent science teachers do not draw well. A few precautions, however, will make it possible for them to use drawings advantageously. In the first place, no drawing or diagram should be placed on a blackboard that has not either been freshly washed or wiped down with an oiled cloth, depending upon the method in vogue in the particular school. Soft crayon should be used. In some instances colored chalk is very effective. Above all, the drawing should be sufficiently large so that it may be clearly and easily seen from all parts of the room. Some teachers find the use of stenciled outlines very helpful, especially in the teaching of physiology and hygiene. They may be placed on the board by pupils, thus saving the teacher's time. There is frequently some gifted pupil in the class who will gladly make freehand diagrams. Large, clear, well-labeled diagrams should be the aim, and not indefinite, shaded work.

Every school should have some of the many types of commercial charts which are available for the different sciences. A chart of the atoms is not misplaced in a General Science room. Although valence and the electron theory will not be taught in the earlier courses, this chart has great interest for these younger pupils. Many boys, and not a few girls, nowadays have or have had chemistry sets. They come into the junior-high-school science classes with some knowledge of the properties of the elements and a keen desire to know more. An atomic chart will mean much to them, and it will be referred to many times by pupils and teacher. A chart of the Metric System, showing its divisions and the English equivalents should be in every General Science room, as a knowledge of the Metric System is fundamental. The entire world, with the exception of the United States and Great Britain, uses the meter, gram, and liter, and all scientific work, even in these countries makes use of Metric units. Our pupils should become well acquainted with this system of weights and measures.

When teaching subjects relative to health and hygiene, charts are a necessity. The Winlow Health Charts, published by the Denoyer Geppert Company, cover this entire field in an admirable way. There are sixteen charts in this set which include studies in anatomy and physiology, and one chart each on the subjects of germ diseases, municipal sanitation, insect enemies, the health department, and living substances of the body.

Many charts covering the fields of beginning and advanced botany are available from different Biological Supply Houses, as are those in the field of zoology, with special material on birds and insects.

The American Medical Association furnishes a set of charts printed on heavy white paper. Most of them deal with the patent medicine evil. There is, however, one chart each on vitamins, calcium in foods, iron in foods, and the caloric content of foods.

The International Harvester Company has fourteen large sets of charts which are loaned free to schools through the Agricultural Extension Departments of the various state colleges. These are of interest mainly in agricultural classes in the Midwest and South, but some of them are

[4] "Making Biology Charts". Turtox Service Leaflet No. 26. Chicago: General Biological Supply House. Free.

[5] "How To Make Laboratory Drawings". Turtox Leaflet No. 22. Chicago: General Biological Supply House. Free.

suitable for use in other sections of the United States.

Cartoons likewise have considerable value. During the last few years many excellent cartoons on conservation, insect control, and allied subjects, have appeared in newspapers and magazines. Lessons are frequently "put over" in this way which would not "get across" otherwise.

The graph has been so widely used during recent years that everyone who reads newspapers and magazines is familiar with it in some of its different forms. Whether it be the bar, circle, curve, or pictorial graph, its purpose is to show comparisons.

The graph is frequently used in science work to show the results of an experiment. In studies dealing with health and hygiene, the simple bar graph is a very effective method of showing the composition and caloric values of foods, or the amounts of alcohol in common patent medicines. If a class has been keeping weather records, the circle graph showing the number of sunshiny or rainy days in the month may be employed. If the solar system is being studied, a pictorial graph may be used to compare the sizes of the different planets.

DEMONSTRATIONS AND DRAMATIZATIONS

A demonstration of some scientific principle may become one of the finest of the several types of visual aids which are used in science instruction. The apparatus which is used gives the spatial dimensions of length, width, and depth as charts or diagrams cannot do.

If a demonstration is to serve its purpose as a tool of visual instruction, the teacher must provide the materials and apparatus which will be needed before the class enters the room. The effectiveness of demonstrations or teacher-performed experiments is too often lessened by the fact that the demonstration is interrupted by the teacher leaving the room in order to search for some needed piece of apparatus.

Dramatizations of scientific principles and historical events are a neglected form of visual instruction in many schools. The success of such motion pictures as "Louis Pasteur" and "Yellow Jack" furnish good evidence that stories of scientific achievement provide acceptable themes for entertainment. Short plays based on such personages as Edward Jenner, or Sir Isaac Newton, or on such events as "A Trip Through The Sky," or "The Evolution of Man's Communication" have been successfully written and staged by junior-high-school pupils. Whether produced for the class, science club, or school assembly those who take part and those who observe profit much from such efforts at dramatization.

The United States Department of Interior through the Office of Education has recently prepared the manuscripts for a number of plays which are sent free to teachers who ask for them. No. 1 of the *Have You Heard Series,* "The Work of Rivers," No. 7 of *American Yesterdays,* "The Johnstown Flood," and No. 3 of *The Safety Musketeers,* "He Didn't Come Up," are suitable for presentation by pupils of the secondary schools.

STILL PICTURES

Still pictures are of several forms; flat pictures, stereographs, and projected pictures, such as the slide, still film, and film strip or pictural.

Some people are said to see sermons in stones. The science teacher who has become visual-minded will find illustrative material in almost every magazine that he picks up. Many people overlook the values of the unprojected picture as found in magazines and reference books because of their enthusiasm over the projected picture. Publishers of all types of textbooks are becoming increasingly lavish in their use of beautifully colored pictures which would have been undreamed of a few years ago.

Like charts, flat pictures are available to all teachers whether they work in city or country schools, and whether or not a

visual education center is nearby to serve them. These pictures may be mounted on stiff cardboard. The author has found that bogus paper makes a very satisfactory mounting medium. This paper wears well, and does not take up as much room in the files as the heavier cardboard. Most pictures can be cut so as to be mounted on letter size paper (8½" x 11"), which can be filed in a manilla folder of the usual size.

The National Geographic Magazine and *The Nature Magazine* have long been sources of excellent pictures. The newer picture magazines, *Life* and *Look*, frequently contain pictures of scientific interest and importance. It is desirable that a school have two copies of the two magazines, *The National Geographic* and *Nature Magazine*. One copy may be filed for reference and the other cut up as needs dictate. In general, pictures in strong black and white are preferable, but with the new autochrome process, many of the colored ones are reliable and superior to those in black and white.

Again attention is called to the material available in the advertising sections of such magazines as *The Saturday Evening Post* and *The Ladies Home Journal*. The articles sponsored by Parke-Davis and Company, and The Metropolitan Life Insurance Company are of particular value in the field of health education. The booklets given out by the different travel bureaus, steamship lines, and various commercial concerns are well illustrated and often contain excellent material.

The kodak record of children's interests should not be forgotten. The pictures are usually small in size but provide material of a very personal nature.

The flat picture has many uses. When used to introduce a new subject, it often serves as a means of stimulating interest and provoking questions by pupils. It may also serve to explain and clarify the portion of the text with which it is used. Arranged on bulletin boards and synchronized with the daily work, flat pictures have a far-reaching effect.

The stereograph is among the older of the visual aids. Its chief value is in providing a third dimension, thus more nearly approximating reality than is possible with older types of pictures. Through their use a more accurate, vivid, and lasting impression is gained. Dorris says: "Of all the static pictures available for school use, the stereograph is unquestionably the most valuable as a means of conveying vivid experiences and accurate mental concepts to the minds of young children." [6]

Some teachers have found that the stereograph does not have as great appeal for pupils of junior and senior-high-school age as for younger pupils. Some excellent views relating to physical geography, astronomy, and nature study are available, however.

The use of stereographs does not permit much class or group activity. They should be treated as reference material and used during a study period for the purpose of building a background of accurate concepts. Pupils should have their attention called to the explanation, if there is such, on the back of each view. If a set of stereographs is arranged in sequence, they should ordinarily be studied in numerical order.

PROJECTED PICTURES

Unless the teacher thoroughly familiarizes himself with the content and nature of visual material before attempting to show it to his classes, he will not be satisfied with the results. This is especially true of projected pictures. Whether slides, still-film, or film-strip are used, a well-taught and well-carried-out lesson requires a preview by the teacher. The slide, still film,

[6] Dorris, Anna M. *Visual Instruction in the Public Schools*. Boston: Ginn and Company, 1928. p. 135.

and film strip greatly expedite the learning process, but they fall short of their purpose unless they are previously previewed and definitely woven into the warp and woof of the lesson plans. Visual education is not a method. Like the laboratory method, it is a means of giving experience, which forms a basis for clear ideas and concepts. One, of course, provides direct, the other, vicarious experience.

SLIDES

When projected on a suitable screen, slides give a clear picture in which the details are brought out distinctly. Excellent slides illustrating all of the sciences may be had from several companies. Teachers and pupils frequently make lantern slides that are valuable teaching aids.[7]

Teachers should be familiar with the outfit furnished by the Keystone View Co., Meadville, Pennsylvania. Blank slides of ground glass, colored pencils, cellophane sheets, especially prepared glass slides, and bottles of various shades of transparent ink are included. The ground glass slides on which diagrams and pictures are drawn or copied may be cleaned and used repeatedly. Transparent inks or water colors may be used for coloring slides. These, too, may be washed off and the slides used again. In each case a clear picture results when the slide is projected. Boys and girls enjoy making these slides, and if wisely directed by the teacher, each pupil may contribute one or more slides during a semester.

Pupils sometimes achieve good results by copying pictures on white tracing paper or on cellophane. By using binding tape or *passe partout,* the copy may be bound between two pieces of clear glass, which can then be used as a slide.

Kodak negatives can be made into slides at a very reasonable cost. It is usually best to have this work done by a reliable photographer. Many fine sets of slides are due to the kodak records of vacations spent among the coast redwoods of California, or in the various National and State Parks.

Slides may be used for class discussion. Unlike the stereograph, they are suited to group activity. They have an advantage over film strip and still film in that they may be shown in any desired order, and all slides in a set need not be shown unless they are needed. They are also valuable in opening new vistas and in arousing interest in a new unit or subject. Slides also provide excellent material for review.

Slides should be selected which are appropriate for the time at which they are shown. They should be chosen to supplement apparatus and experiments, and be closely integrated with the succeeding, if not the previous, day's work. Caution must be used in order to avoid showing too many pictures at one time. The teacher may be tempted to show as many pictures as he can put through the projection machine during one class period. He may have the use of them for only a few days, or he may be anxious to keep his expected place in the course of study. There are many reasons for too great haste, but speed may defeat the purpose of the slides, and the time spent on them may be largely wasted. In the introduction to *Visualizing the Curriculum*[8] the authors state on page 1: "There is just as much danger in the overuse of visual aids as in their underuse."

FILM-SLIDES, FILM-STRIPS, PICTUROLS

The film-slide, film-strip, or picturol, as it is variously called, is among the newer additions to the many types of visual aids. These newcomers have not been appreciated and as widely used as they deserve, but such splendid material is being produced by several companies that they will

[7] "Lantern Slides Any Teacher Can Make", Turtox Leaflet No. 45. Chicago: General Biological Supply House. Free.

[8] Hoban, Charles F., Hoban, Charles F., Jr., Zisman, Samuel B. *Visualizing the Curriculum.* New York: The Cordon Co., 1937.

surely grow in use and favor. Each film-strip is relatively inexpensive. Some strips consist of as many as 150 separate pictures. With a good projector the film-slide gives as clear close-up pictures as the glass slide, and it has the advantage of being nonbreakable and less expensive. The film-slide does not, however, give as good results with distant shots and those requiring great detail.

There is a vast amount of science material to choose from. The various subjects are edited by experts in their respective fields of health education, physiology, biology, electricity, physics and general science. Some excellent material on astronomy is available for use in general science or other elementary science courses. The United States Department of Agriculture has recognized the value of the film-strip and has had many sets of glass slides reproduced as film-strips. These may be purchased for less than the cost of shipping the same pictures as slides. Fifty glass lantern slides packed for shipment weigh about fifteen pounds. A film-strip containing the same pictures weighs but a few ounces and can be sent in the mail for a few cents.

The film-slide has values and uses similar to the stereopticon slide. They may be used as introductory material, as a means of review, or for giving material in addition to that included in the text.

Schools located in rural districts, far from centers of slides and motion picture films, and in small systems where owning films is out of the question, will have their problems largely solved by securing a supply of these film-slides or picturols. There are some which may be supplied free, and few cost more than two dollars each. It is evident that a small amount of money will purchase much material. An ingenious teacher may enlist the interest and aid of the Parent-Teacher Association, or other local organization if the school board cannot be persuaded to provide these teaching aids. Some teachers use a candid camera, and make their own film-strips to suit individual needs and purposes.

STILLFILM

The stillfilm produced by Stillfilm, Incorporated, Hollywood, California, is similar in uses and purposes to the film-strip or picturol. It provides for sequence, continuity, and democratic participation by the class. Practically all of the material that can be used in science classes is listed under the heading of *Nature Study*. Being wider ($2\frac{1}{4}''$), the stillfilm requires a different projection machine than the film-strip ($1\frac{3}{8}''$), although the standard machine can be used with an attachment that costs less than ten dollars.

This section on projected pictures would be incomplete without a brief mention of the projection of opaque pictures on the screen. By the means of an opaque projector, one may use photographs, post-cards, pages or pictures from books and magazines, stamps, maps, charts, drawings; in fact any flat, opaque object may be presented on the screen. The teacher is not dependent upon rented films, slides, or film-strips which may or may not arrive on schedule time. He may very easily assemble his own collection of materials to illustrate any subject in the general science course.

The opaque pictures may be used to present new and interesting information. By using a limited number of pictures at one time, there is opportunity for questions and discussion while the pictures are on the screen. The questioning should not be done by the teacher alone; pupils should have their opportunity to make inquiries and to explain, often to the instructor's surprise and gratification, the pictures under consideration.

After a unit or topic has been completed, a set of opaque pictures may be shown to summarize the work of several weeks. Thus an interesting review lesson

is provided. Pupils may be encouraged to select and prepare material for such a lesson, which is often more effective than the teacher's presentation that too frequently becomes a formal lecture.

MOTION PICTURES

Many individuals think of motion pictures when they hear or see the term visual aids. However, Hoban, Hoban, and Zisman stated in 1937 [9] that less than 10 per cent of the schools of the nation use the powerful new tool of teaching, the motion picture.

The motion picture film is the most expensive of all the visual aids. However, there are times when it is the most effective of the several forms of these educational tools. The director of Visual Instruction of the Extension Division of the University of Wisconsin is quoted as follows:

"Motion pictures are not only useful but may safely be regarded as a necessity where a problem to be solved by a class is a problem of *motion*, essential action—where a life process is to be demonstrated, where life activities of individuals or communities or peoples are involved—and especially where such knowledge cannot be gained by any other means or devices within the reach of the teacher. And there are thousands of such problems that can be solved in no other way—the intimate processes that go on in a gas engine, the peristaltic action of the digestive tract, the intricacies of the blood circulation, the metabolic changes that take place in the tissues, the way an individual lives and moves and has his being; success in life from the standpoint of a starfish, of a bird, of a hottentot, the vocations of the people of Borneo, how the Eskimoes of the frozen North live and love and treat one another, how the people of by-gone ages solved the problems of existence peculiar to their times and their environments—their industries, their courtships, their home life. All these activities and life expressions can be re-lived, can be vitalized only by means of motion pictures, lacking which the student must be content with the east wind of authority. . . . But the films must measure up to the standards just pointed out; they must present *essential action:* they must depict life processes, . . . and each reel truthfully, sincerely and tersely must drive home an important lesson convincingly and as nothing else can do." [10]

The best films, like the best texts, are at this time organized on the unit basis. It is the ambition of the producers to offer well-edited, comprehensive films that will include the subject matter which is usually found in general science, biology, physics, and chemistry courses. Many of the films that have been developed by the Eastman Company and other producers are not suitable for the general assembly of the school. Like certain pieces of apparatus and referance books, they have value only for a given group at a given time. In the field of general science the Eastman Kodak Company has made notable contributions with their films, *Atmospheric Pressure, The Water Cycle, Simple Machines,* and so forth.

Young teachers, especially, should be warned that the motion picture in the classroom is not a substitute for supervised study, experiment, discussion, and review. It has, to be sure, an important place in the technique of instruction, and may serve a variety of purposes. Some films may be used to illustrate correct scientific method. The Eastman Film, *Food and Growth,* serves this purpose. Other films illustrate special laboratory techniques, as for example the Eastman Films, *Bacteria* and *The Blood.* Still others may be used in lieu of excursions or school journeys. Children who live far from the mountains or the sea may have the vicarious experience of visiting these regions through viewing the Eastman Films, *Rocky Mountain Mammals,* and *Some Seashore Animals.*

Many experiments have been undertaken to learn the place of the classroom film as a means of instruction. One of the earliest of these experiments was directed by Wood and Freeman. Two groups of children of like proven abilities were used

[9] Hoban, Charles F., Hoban, Charles F., Jr., Zisman, Samuel B. *Visualizing the Curriculum.* New York: The Cordon Company, 1937. p. 13.

[10] Dudley, Wm. H. "The Place of Motion Pictures in Education." *Visual Review,* 1929. pp. 9–13.

for this experiment. One group received instruction by means of films, and the other group without films. The teachers who taught with films reported that they were able to arouse more than the usual interest in their pupils, and that this was a sustained interest, as was indicated by the fact that the children read more than the usual number of books on the subjects covered by the classroom films. The pupils were also stimulated to carry out projects and other self-initiated activities which sometimes took the form of written reports on some of the topics that had been covered in the pictorial lessons. Others were led to connect the films with their own experiences and with community conditions. In many children, greater originality was quickened than had ever before been thought possible, and the teachers themselves derived greater pleasure from teaching.[11]

Attention has been called to the fact that a preview on the part of the teacher is necessary before any of the various types of visual aids is used. This is especially true of the motion picture. Even if all precautions are taken and adequate preparation made, some sharp-eyed youngster will see and ask questions about some detail that escaped the teacher's notice. This is as it should be, for the periods given over to the use of visual aids and the discussion that follows are best conducted on a socialized-recitation basis, permitting pupils to ask questions and contribute their experiences and information concerning the subject being studied. However, the skillful science teacher knows the backgrounds and capacities of his group. During the showing of a film, a word here and there where really needed is more helpful than a sustained barrage of explanation, part of which is necessarily confusing and distracting to immature students.

[11] Wood and Freeman. *Motion Pictures in the Classroom.* Boston: Houghton Mifflin Company, 1929. pp. 332–386.

The following suggestions for the successful presentation of moving pictures in the classroom may well be heeded.[12]

1. Motion pictures should only be shown after thorough preparation of the class.
2. Only one reel should be shown at one time, unless more are necessary for the adequate presentation of a single subject.
3. The teacher should preview the film, making note of all particulars to which he wishes to call the attention of the class.
4. The machine should be threaded, ready to operate, before the class convenes. No class time should be used in adjusting apparatus unless absolutely necessary.
5. Before the room is darkened, the class should be given the subject of the reel to be shown and the pertinent facts necessary to the understanding of the film. A few comments by the teacher may be necessary while the film is being shown if the pupils are to comprehend fully all details.
6. If more than one reel must be shown at a time, it may be that one of the pupils can change the reels while the teacher engages the attention of the class with prefatory information on the second reel.
7. Immediately after the film is shown, there should be a short discussion on what has been presented; comparisons should be made with facts previously known to the children; questions should be asked and answered.
8. The new knowledge gained may be determined by a short test of simple form, such as a true-false, a multiple-choice, or a completion test.
9. Rerun the film as often as necessary.

SOUND PICTURES

The most recent addition to the many types of visual aids suitable for use in science classes is the talking picture, which

[12] Israel, Marion Louise. "A Brief Manual of Visual Instruction." *Visual Review,* 1929. pp. 26–40.

is the most expensive and the most difficult to use of the many instructional aids that are available.

The University of Chicago has sponsored the production of many talking pictures as an integral part of its new educational plan. These pictures were planned for the purpose of giving the student knowledge which the student cannot get elsewhere. These pictures were produced by Erpi Picture Consultants. Some of these films which can well be shown in the junior high school are—*Plant Growth, Seed Dispersal, Plant Traps, Leaves, The Frog, The House-Fly, Ground Water, The Solar Family,* and *The Moon.* After viewing these pictures and listening to the lectures which accompany them, we must conclude that some of them, at least, are of such common subjects that the pupil need not rely upon sound films for information concerning them.

Many teachers prefer the silent to the talking picture, believing that a running commentary distracts rather than helps pupils to gain the salient points of the film. More testing and experimentation with it as a medium of instruction are necessary before its value as a teaching tool can be definitely stated. In the text, *Visualizing The Curriculum,* the authors point out five values of the sound film.

"1. The inclusion of natural sound provides a close approach to subjective reality in the experience of pupils.

2. The use of sound in instructional motion pictures provides the auditory element essential in a number of subjects in the present-day curriculum, to which the other pictorial aids are not adapted.

3. The sound picture is particularly adapted to any grade level or low ability group in which reading difficulty is an obstacle to learning through the more generally used media of instruction.

4. The sound picture presents unvarying oral explanations.

5. The sound picture incorporates direction of pupil attention and learning to important aspects of the film content as it is being projected." [13]

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[13] Hoban, Charles F., Hoban, Charles F., Jr., Zisman, Samuel B. *Visualizing the Curriculum.* New York: The Cordon Co., 1937. pp. 108–113.

TEACHING SCIENTIFIC PROCEDURES AND RESEARCH TECHNIQUES THROUGH CLUB ACTIVITIES

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Inevitable questions are being raised and problems propounded in the mind of every teacher pertaining to the organizing of school clubs. The teacher is interested in the formation of a club which will challenge and fulfill the interests, abilities and expectations of its members. What teacher, even those with wide experience in organizing and conducting club work, does not partake of the spirit of doubt as well as hope and eager anticipation, with the formation of each new club?

As the result of numerous requests from students, the writer undertook the organization of a science club different from any other under his previous adviserships. The club, in its third year of operation, is well organized and results, now evident, are justifying the time and energy given to it. Believing in the club's possibility this account of its organization, objectives and program of activities is given in the spirit of suggestion to teachers interested in supplementing regular classroom instruction with certain phases of science instruction presented through extra-curricular activities.

From various names suggested, the one chosen for identifying the club was, "Science Research Club," and it serves the useful purpose of bringing together the science students who manifest an interest and have the ability to do an investigation of a research character.

It is admitted, without hesitation, that scientific research in the secondary schools has limitations, due primarily to the young student's undeveloped judgment, immature mind and limited science knowledge and training. The problems selected for investigation must not be of a too difficult nature if they are to be feasible to the high school student. However, the secondary student can pursue investigations involving research techniques, which are suitable to their ability and training level. Certainly, in this scientific age, it behooves them to have some familiarity with that type of procedure. To actually acquire an intelligent understanding or to gain a substantial degree of proficiency in dealing with problems which involve research techniques, the secondary student must repeatedly be given the opportunity to practice such undertakings. Extensive individual assistance along this line is not always possible during regular class work. This is true especially where the enrollment per class is high and it is doubtful if students are able to acquire this understanding from teachers and textbooks alone. Class and club work should supplement each other. One objective of this article, therefore, may serve to emphasize that despite limitations a club directed toward that end does have a place in the secondary school.

BASIC PRINCIPLES OF ORGANIZATION AND PROCEDURES

Accepting the opinion that a club's organization and membership should be voluntary, the author purposely does not introduce to his Biology students in the fall the idea of club formation. After school has been in session for several weeks the student's attention is directed toward club activities by organizations forming in the various departments. The student inquiry concerning a Science Club offers me the opportunity to give an evaluation of the meaning, purpose, value and practice of the Science Research Club. A brief of the plan upon which the club is founded follows:

1. Membership to the club is voluntary.

2. Members may, if they desire, be enrolled with the club for three years.

3. An effort is made to widen the student's association and the type of activities by drawing members from the biology, physics, and chemistry classes.

4. To encourage efficient organization and facilitate individual assistance, the enrollment is kept at a low figure.

5. Continued membership to the club depends upon the student's interest and willingness to cooperate.

6. There are two meetings each month. Business meetings are held after school hours.

7. Business meetings are of a round table discussion nature. The manuscripts of the articles prepared following investigation are read and discussed. Demonstrations are also presented. Suggestions for improvement or continued study are made by members or adviser.

8. Social aspects are given considerable emphasis. The club has played a major part in organizing social activities for the department. Consult *Science Education*, March, 1939.

CONDITIONS TO MEMBERSHIP

A student's candidacy to membership is subject to the conditions listed below.

1. Be a student in our high school.
2. Have background in science training.
3. Be willing to spend the necessary time to investigate problems of the student's own choice and interest.
4. Must apply for membership to the club in writing, stating reasons for desiring to become a member. A careful surveillance of the candidate and his application is made by the Advisory Committee. By so doing, an honest effort is made to admit as members only individuals who are genuinely interested and alive to the importance of the program.
5. Agrees to submit a written report of the findings pertaining to problems undertaken for investigation. In this connection, it may be stated that, (a) final reports are typed, (b) paper of a uniform size is used for each report, (c) reports are filed in a notebook, and (d) reports are available to members and classes at all times.

(The written report is, I believe, one of the most worthwhile contributions of the club. This is true from the point of view of the individual member and the science department as well. By submitting a written report, the individual must crystallize thinking and, at the same time, make certain the question is adequately answered. The reports contribute to the regular class work. Students are referred to them when an occasion presents itself.)

INDIVIDUAL DIAGNOSIS

As early as possible after the club is organized the adviser should determine the assets of the club's members. To this end a careful diagnosis of the group should be made to reveal the individual fitness for certain types of work. Mimeograph copies of the sample forms which follow are used to secure and keep data pertaining to members.

PART I

Please fill in the desired information in Parts I and II. Under Science Training place a check in the appropriate place for each science course you have had or are now taking. The item marked I.Q. will be filled in by the adviser.

PART II

1. Give a brief description of any special abilities you have; namely: drawing, writing, photography, wood working, metal working, etc.

2. In which field of science are you especially interested? _____

_____

3. Do you plan to follow a scientific career? If so, describe it. _____

_____

PART III

Do not write below this line.

Member (office held)	Birth Record			I.Q.	Term of Membership 19... to 19...	Science Training											
						Elem.						Jr.-Hi.			Senior Hi.		
	Year	Month	Day			1	2	3	4	5	6	7	8	9	Bio.	Phy.	Chem.

RECORD OF MEMBER'S PROGRESS IN CLUB

Problem selected by member	Date Started	Date Finished	Adviser's Comments

RESPONSIBILITY OF THE ADVISER

Due to his professional knowledge and wide experience, the adviser should, when the club is being organized, take a predominate interest in organizing, directing and supervising the club's activities. As the members, and particularly the officers, mature in age and experience, they may be delegated more opportunity for taking the initiative. At all times, the members should recognize their adviser as their leader, inspirer and friend of the club body. Specifically the most significant obligations of the adviser to the club may be summarized as follows:

1. To induce successful outcomes the adviser will make certain that each member of the group has selected for investigation a problem which is within the range of his ability.

2. Make certain each member is supplied with whatever equipment is necessary for a successful pursual of the problem under investigation.

3. Aid the beginner in locating literature and forming ideas pertinent to an understanding of his problem.

4. Consistently offer cheerful encouragement to the member to draw freely upon his professional knowledge and experience.

5. Equalize his attention to all members of the club.

6. Hold regular conferences with the members to learn of their progress and give suggestions for improvements.

7. Should frequently be in contact with the officers to inspire them with zeal and develop a spirit of cooperation.

8. Work with the officers to plan future developments of the club.

9. Assist the officers to present consistently worthy and interesting club objectives and support them in attaining them.

10. Does not allow petty disturbances to become a disintegrating factor, but rather strives at all times to maintain the club in a dignified manner and assists in promoting club esprit de corps. Anything else is disgusting and will kill interest and confidence in the schedule.

PROBLEMS INVESTIGATED BY MEMBERS

When a member selects a topic for investigation he may choose it from the following sources: (a) Select a problem of his own choice and interest, or (b) from mimeograph sheet which the adviser has prepared. Irrespective of its source, the problem must have a direct bearing on the individual's life and interest. The outline

of topics which follows are representative of those selected for investigation by members of my club.

1. The number and nature of illnesses which cause students' absence from our school. Absence converted into school hours missed by students.

2. Type and prevalence of disease in our city since 1920. This study was possible through the cooperation of the local Department of Health.

3. Collect and study examples of deviation from the normal in plants and animals.

4. Do germinating seeds release carbon dioxide?

5. Observe things in nature for story material.

6. Cross-pollination experiments.

7. Plant grafting experiments.

8. Does the average person observe ordinary rules dealing with safety?

9. The effects of geotropism and hydrotropism on plants.

10. Make a study list of superstitions.

11. What has research accomplished in its study of vitamins?

12. Study list of strange plants and animals to be found on the earth.

13. List common tools used by man. Did plants or animals use the scientific principles involved before man?

14. List plants and animals which are extinct and the probable or actual cause of extinction. Which plants and animals are liable to extinction? Why?

15. Construct a maze and experiment with animal intelligence.

16. Trace a family trait for as many generations as possible.

17. What are some new frontiers for science?

18. Plaster cast work.

19. Which plants may be successfully grown indoors? How would you care for them?

20. Construct a vivarium for the home.

21. Construct a terrarium for the home.

22. Find a method for determining whether green plants release oxygen. When is oxygen released by the plant?

23. Methods by which science aids in solving crime.

24. The problem and importance of bird banding.

25. Why are the Galapagos Islands and Laysan Islands of interest to scientists? Using papier-maché to construct scale models of these islands.

26. How does the color of animals influence our life?

27. America has become a motorized nation. How does this affect our lives?

28. Make a study of parasites which affect man. How would you use this information if you were traveling?

29. Why should science be free for thought and experimentation?

30. Observe a small child for a period of one year. List the changes noted.

31. What would you have to know about insects if you desire to control them in and about your home?

32. Do plant roots give off acid?

WORKING THE PROGRAM

Previously, emphasis was placed on the necessity for close cooperation between the adviser and members. This is especially true in the early stage of problem solution planning. If young students in this type of work are thrown entirely upon their own resources, they may make a valiant effort to succeed, but in the end may fail because of poor judgment, lack of knowledge or experience. It does not require many unfavorable vicissitudes to deaden interest. The writer believes, whenever possible, the contributions should come from the student rather than the adviser. As the students mature in age, experience, practice, and gradually begin to think for themselves, the adviser may withdraw assistance—giving only the amount of help and advice necessary to affect a successful conclusion.

By way of illustrating, an outline will be presented of the method used to assist the member after a definite problem has been

selected for investigation. A conference is held between the student and the adviser. Together we plot the basic outline around which the student will undertake his independent solution to the problem. The student should obtain enough from this conference to give him a clear picture of his problem. If possible several references are cited for a point of beginning. Following the conference the student knows he is free to come to the adviser whenever there is a need.

To give a clearer idea of the results obtained during a conference, I will quote from typed paper before me. The question involved was Number 31 in the preceding outline of topics above.

The following chart and outline resulted.

2. Eggs.
   (a) manner of laying eggs, as singly or in mass, (b) place of laying eggs, (c) number of eggs, (d) time of laying eggs, (e) are all eggs laid at the same time?
3. Manner of locomotion.
4. Type of skeleton.
5. Manner of breathing.
6. Size and color of insect.
7. Control measures.
   (a) traps, (b) baits, (c) poison in relation to food and breathing, (d) natural enemies as a control factor.
8. Make a list of poison baits and traps. Classify according to use.
9. Secure literature pertaining to insect control from the following sources. (a) Local Hardware Store, (b) Local Drugstore, (c) Manufacturing Companies, (4) State Department of Entomology, (e) Federal Bureau of Entomology.
10. What effect does humidity have on insects?
11. How does cold storage aid in controlling insects?

CHART I. INSECT PESTS IN THE HOME

Insect	Damage or Danger	Control Method	Danger to human or pets resulting from control

CHART II. INSECT PESTS OUTSIDE THE HOME

Insect	Damage or Danger	Control Method	Danger to human or pets resulting from control

PHASES OF INSECTS TO BE CONSIDERED

1. Life history of insect.
   (a) Type of metamorphosis, (b) appearance during each stage, (c) type of mouth, (d) food—each stage, (e) habitat.

The details of procedure with other students and their problems are similar in nature to the one outlined. It will not be necessary to go into details with them. Enough has been said to show what may be accomplished through wise planning.

AIMS AND OBJECTIVES GOVERNING PHYSICS SURVEY AND PHYSICAL SCIENCE SURVEY COURSES AT THE COLLEGE LEVEL

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During the past year, the author has completed a nation-wide study[1] on the problems confronting survey courses in physics and physical science in the universities, colleges, teachers colleges, and junior colleges in the United States. The results reported in this article are taken from that portion of the study which was concerned with the aims and objectives governing these courses, and the data were compiled from responses submitted by one hundred and twelve institutions with a wide range in size and geographical location. Of these, fifty-six were universities or colleges, twenty-three were teachers colleges, and thirty-three junior colleges. Survey courses including more than one of the physical sciences (called in this article Science Survey courses) were represented by eighty-five institutions, while survey courses in physics alone (here designated as Physics Survey courses) were represented by twenty-seven institutions.

As a basis for selection of objectives upon which the cooperating teachers could place a ranking, the extant literature upon aims and objectives for science teaching were scrutinized, after which a list of twenty-four objectives was arbitrarily chosen as being inclusive of the primary objectives suggested in such literature. Certain objectives which seem ordinarily to be expected of pre-professional science courses rather than of courses offered primarily for "general education" were included in this list as a means for checking the consistencies of the survey courses. This was believed to be of extreme importance to the study, since a high ranking accorded to any of these technical objectives would show a tendency to make these courses merely pre-professional courses masquerading under liberalized titles.

Of course, more freedom would have been accorded the individual instructors to express in their own goals for these courses which they are teaching if they had been allowed to express in their own terms such objectives, but, obviously, this would have created a bulk of answers too large to be dealt with without an eventual reclassification into small, like units. And so it seemed advisable to submit to them the arbitrary list and allow them to append any statement of personal objectives which they felt had been omitted from the list. However, the instructors must have felt the list to be complete, since no further objectives were suggested by them.

With the testing program upon the matter of aims and objectives in the embryonic stage that it now is, it is understood that any attempt to discover whether or not the teachers actually have been successful in the realization of the aims and objectives to which they have subscribed in the following responses would be futile at this time. However, the mere fact that they give assent to emphatic stress of certain aims, even though as far as objective proof is concerned it remains only assent, and that they give complete denial to certain other aims, would seem of significance in a study of the make-up of these new courses.

A five point scale was set up for these

[1] "An Empirical Determination of Standards Affecting Science Survey and Physics Survey Courses." Unpublished Doctor's dissertation, submitted in partial fulfillment for Doctor of Philosophy Degree, University of California, 1939.

responses, allowing each juror to check the relative emphasis he accords to each objective: "very high," "high," "medium," "low," and "zero." Table I was made up by counting each "very high" response as a score of "4," "high" as "3," and so on. The total responses for each objective were averaged and presented as a numerical score. Thus, an average score of "3" on the table would mean that the majority of the instructors place "high" emphasis upon that objective. Table II translates these point scores into a twenty-four point ranking, showing the relative values assigned to all the objectives listed, as based upon the average evaluations assigned to them by the instructors.

The twenty-four objectives appearing on the list were not, at the time they were submitted to the teachers, classified or

TABLE I

SHOWING RANKINGS BY POINT-SCORES ACCORDED CERTAIN OBJECTIVES IN PHYSICS AND PHYSICAL SCIENCE SURVEY COURSES

Objective:	*Point-scores* Science Survey	Physics Survey	Both
Group A. General objectives of science and physics courses:			
1. Acquisition of science knowledge	3.21	3.04	3.17
2. Understanding of fundamental laws and principles	3.30	3.18	3.27
3. Acquisition of skill in mathematical problem solving	1.20	.96	1.14
4. Acquisition of skill in laboratory technique	.73	.72	.72
5. Ability to explain natural phenomena in a satisfactory manner	3.17	2.96	3.12
Group B. Objectives generally regarded as secondary in regular pre-professional courses in science, but stressed in survey courses:			
1. Development of use of scientific method of attack upon problems	2.94	2.27	2.77
2. Willingness to change opinion upon presentation of new data	3.10	2.35	2.90
3. Requirement of adequate data or evidence for conclusions	3.16	2.42	2.96
4. Concept of cause and effect	2.86	2.63	2.81
5. Power to distinguish between fact and theory	2.86	2.56	2.78
6. Knowledge that truths are only relative	2.56	2.44	2.54
Group C. Development of interest in and appreciation of the work of science:			
1. Awareness of great need for continued research	2.49	2.35	2.46
2. Awareness of dependence upon technology	2.73	1.92	2.50
3. Appreciation of individual scientists	2.38	2.23	2.35
4. Historical development of scientists	1.99	2.08	2.02
5. Appreciation of the action of physical phenomena	2.18	2.38	2.61
6. Appreciation of the orderliness and beauty of the natural world	2.59	2.68	2.60
7. Development of inquisitiveness concerning environment	2.91	2.54	2.82
Group D. Social significance of science:			
1. Interpretation of scientific discoveries in terms of social significance	2.73	1.92	2.50
Group E. Objectives concerning student adjustment and orientation:			
1. Development of hobbies	1.35	1.04	1.28
2. Exploration of opportunities of science as a vocation	1.80	1.28	1.65
3. Freeing from groundless fears, superstitions, and quackeries	3.13	2.75	3.03
4. Acquisition of taste for popular scientific literature	2.40	1.69	2.12
5. Acquisition of vocabulary adequate for current scientific literature	2.73	1.92	2.50

TABLE II

RANKINGS OF VARIOUS OBJECTIVES SOUGHT IN PHYSICAL SCIENCE SURVEY AND PHYSICAL SURVEY COURSES

Objective:	Ranking					
	UC *	Science Survey TC	JC	Total Science Survey	Total Physics** Survey	Both
Group A. General objectives of science and physics courses:						
1. Acquisition of science knowledge	3	3	7	2	5	3
2. Understanding of fundamental laws and principles	2	1	1½	1	1	1
3. Acquisition of skill in mathematical problem solving	23	22	23	23	23	23
4. Acquisition of skill in laboratory techniques	24	23	24	24	24	24
5. Ability to explain natural phenomena in a satisfactory manner	4	2	3	3	2	2
Group B. Objectives generally regarded as secondary in regular pre-professional science courses but stressed in survey courses:						
1. Development of use of scientific method of attack upon problems	10	5	9	7	14	10
2. Willingness to change opinion upon presentation of new date	6	6	8	6	12	6
3. Requirement of adequate evidence for conclusions	7	4	4	4	10	5
4. Concept of cause and effect	11	7½	6	10	6	8
5. Power to distinguish between fact and theory	8	7½	13½	9	7	9
6. Knowledge that truths are only relative	14	12	16	15	9	13
Group C. Development of interest in and appreciation of the work of science:						
1. Awareness of great need for continued research	13	20	11	16	13	16
2. Awareness of dependence upon technology	17	19	13½	17	18	17
3. Appreciation of individual scientists	15	14	20	19	15	18
4. Historical development of science	19	18	21	20	17	20
5. Appreciation of the action of physical phenomena	12	9½	10	12	11	11
6. Appreciation of orderliness and beauty of the natural world	5	15	15	14	4	12
7. Development of inquisitiveness concerning environment	9	11	5	8	8	7
Group D. Social significance of science:						
1. Interpretation of scientific discoveries in terms of social significance	16	13	12	13	16	14
2. Awareness of dependence upon technology	17	19	13½	17	18	17
3. Awareness of great need for continued research	13	20	11	16	13	16
Group E. Objectives concerning student adjustment and orientation:						
1. Development of hobbies	22	24	22	22	22	22
2. Exploration of opportunities of science as a vocation	20	21	19	21	21	21
3. Freeing from groundless fears, superstitions, and quackeries	1	9½	1½	5	3	4
4. Acquisition of taste for popular scientific literature	21	16	17	18	20	19
5. Acquisition of vocabulary adequate for current scientific literature	18	17	18	19	11	15

* UC—Universities and colleges.
TC—Teachers colleges
JC—Junior colleges

** Insufficient number to show true tendency when divided into institutional classification.

grouped according to any system of similarity or relationship. However, for ease in consideration and criticism here, the tables of responses are divided into five classifications or groupings. The first group contains those objectives which are primarily expected of regular academic or pre-professional courses in science, but which, with adaptation, seem suitable also for survey courses. Group B contains those objectives generally regarded as secondary or incidental in pre-professional courses, but perhaps considered as advisable to be stressed in survey courses. Group C concerns the development of interest in and appreciation of the work of science; Group D includes the objectives related to the social significance of science; and Group E is concerned with the matter of student adjustment and orientation. Where certain of the aims and objectives seem necessary to more than one classification, they have been included a second time in the tables.

One of the first things noticed in Table I is that instructors in Physics Survey courses mark the entire list lower, with the exception of two objectives, than do the Science Survey teachers. The two objectives marked higher by the former group are "appreciation of the orderliness and beauty of the natural world," and "appreciation of the action of physical phenomena." There also seems to be some divergence of opinion concerning the various objectives when the tables are studied from the standpoints of type of institution reporting. But it is found that when the average from all the schools is taken without particular regard for the various types of schools represented, but with consideration of the type of course reporting, there is an agreement in general between the teachers of the Science Survey courses and the Physics Survey courses upon the objectives included in this list.

The significant findings seem to be the following:

1. Objectives concerned with individual adjustments are marked very high. Among these, "freedom from superstition" was given highest place by instructors in universities, and colleges, and junior colleges. Also, looking at the objectives under other groups, most instructors agreed that an "understanding of fundamental laws and principles," "acquisition of general scientific knowledge," and "ability to explain natural phenomena," were very important.
2. Objectives common to professional courses, or that would tend to develop specialists, were given lowest ranking. Even the ones concerning hobbies and vocational possibilities of science were marked very low, so that it seems to be rather conclusively shown that the teachers of survey courses do not see them as "feeder" courses to other science courses, or as possibilities of "orientation" courses in any way, despite the fact that some administrators recommended their inauguration with this latter purpose in mind.
3. Survey courses are not, according to the results of these tables, at the present time emphasizing the social implications of the work of scientists nor the need for continued research.
4. The history of science, a topic which one might have expected to find given stress in a "layman's" course, is not considered important in the work of these survey courses.
5. Considerable difference of opinion exists between institutions and also between types of courses as to the importance of the "development of the scientific method of attack upon problems," and the items concerning the appreciation of science and the physical world.

In other words, the study seems to show that the instructors of these two types of survey courses are in close agreement as to the relative emphasis which they wish placed upon the various objectives governing their teaching of these courses. They seem to subscribe to an emphasis which is centered upon objectives intended to give to the layman an appreciative understanding of the facts and procedures of science. However, the relatively less emphasis which they wish to have placed upon the social significance or implications of science, and upon historical and biographical aspects of the subject, seems to point rather conclusively to the fact that they have determined to keep these courses as courses "in" science rather than courses "about" science.

A STUDY OF NATURAL SCIENCE SURVEY COURSES IN NEGRO COLLEGES

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In keeping with recent trends to make the college curriculum function more effectively as a directive force in the lives of its students, many of our Negro colleges have begun to include the general survey courses in the humanities, the social studies, and the natural sciences as part of the first two years of college work. In substance the purpose of such courses is to lay a broad, general background which will assist a person in living. According to the old traditional concept of education, emphasis was placed on the acquisition of factual information; such information, however, has no value in and of itself. It has value placed on it in so far as it has bearing on social life and in so far as it has bearing on what individuals need to do and to construct. It is the development of a functional understanding of the major generalizations of science, the scientific attitudes,[1] and the elements of the scientific method[2] that are of particular value in assisting an individual in directing, appraising, and controlling his own conduct which is concrete and specific. If the place of science in the general education program is to be justified, its basis of justification must come in so far as it affords the student the opportunity, through experience, to use vision, self-direction, self-appraisal, self-control, and cooperation with others for his own individual growth and for the growth of the community of which he is a part.

[1] *A Program for Teaching Science.* Thirty-First Yearbook of the National Society for the Study of Education, Part I. Bloomington, Illinois: Public School Publishing Company, 1932. Pp. 53–57.

[2] Francis Day Curtis. "Teaching Scientific Method." *School Science and Mathematics* 34: 816–818; November, 1934.

While certain standards and degrees of achievement should be formulated regarding these courses certainly schools offering survey courses in science may use, as a basis for arriving at suitable and useful standards and objectives, the practices that are being used in other schools that compare favorably with their own. It seemed fitting, then, because of the widespread acceptance of the general college idea and because of the interest that has been manifested in the survey courses in science, to determine the status of this type of course in our Negro colleges and universities.

In making this study it seemed advisable to include just those schools rated by their regional accrediting agency; the assumption being that the type of instruction given in such courses was such as to make it acceptable to these rating agencies. I have no doubt but that in many of the other colleges not so rated survey courses in science are being taught, but the fact that these colleges are not rated by their regional accrediting agency precluded their being included in this study.

From a study of the catalogs of the colleges and junior colleges on the *List of Approved Colleges and Secondary Schools for Negro Youth* for the year 1938–1939 of the Southern Association of Colleges and Secondary Schools, twenty-three schools offered survey courses in science for the year 1938–1939; Miner Teachers College, Washington, D. C., rated by the American Association of Teachers Colleges, Lincoln University, Jefferson City, Missouri, and West Virginia State College, Institute, West Virginia, rated by the North Central Association of Colleges and Secondary Schools also offered such courses.

Twenty-six questionnaires designed to obtain the desired information were sent to these institutions; nineteen were returned with only a small proportion of the items unanswered.

Of the total number of schools offering survey courses in science, 15 offer two separate survey courses, one in the physical sciences and one in biological sciences; 3 offer courses that deal with just the physical sciences; 1 offers a three-quarter sequence: Section 1 (biology). Section 2 (chemistry), Section 3 (physics); one offers a combined course in chemistry and physics; and one for which I had no information other than that a survey course in science is offered completes the study. The following states represent the distribution of schools: Texas, Virginia, West Virginia, North Carolina, Georgia, Missouri, Louisiana, Florida, Alabama, Tennessee, Kentucky, and the District of Columbia.

It is seen from Table I that there is very little uniformity in the titles given to the courses. In cases where separate courses are offered the titles, Survey of the Biological Sciences and Survey of the Physical Sciences, are used in 5 schools; 4 use the titles, Introduction to the Biological Sciences and Introduction to the Physical Sciences. In cases where one course is offered covering just the physical sciences 3 schools use the title, Physical Science Survey. Where only one course, cutting across both the physical and the biological sciences, is offered, 2 schools use the title, General Science, and the other 3 schools use titles that suggest the broad nature of the courses that are being offered.

The following table shows the years in which the different schools introduced either one or both of their survey courses.

TABLE I

TITLES GIVEN TO THE SURVEY COURSES IN SCIENCE

Titles	Frequency
Combined course in Physics and Chemistry	
Matter and Energy	1
Biology, Chemistry, and Physics sequence	
Survey of Science	1
Courses covering just the Physical Sciences	
Physical Science Survey	3
Two separate courses	
Survey of the Biological Sciences Survey of the Physical Sciences	5
Science Survey: Physical Science Survey Biological Science Survey	1
Introduction to the Physical Sciences Introduction to the Biological Sciences	4
Introduction to the Sciences	1
Introduction to the Natural Sciences	1
Natural Science	1
Orientation Science: Physical Sciences Biological Sciences	1
Science	1
One course cutting across both the Physical and the Biological Sciences	
General Science	2
The Scientific Aspect of Knowledge	1
Introduction to Science	1
Orientation to Science	1

TABLE II

YEARS IN WHICH THE SCHOOLS INTRODUCED THE SURVEY COURSES

Year	Frequency
1932	1
1933	4
1934	2
1935	4
1936	5
1937	2
1938	1

It is seen from the replies to this questionnaire that the first survey course in science was offered in our Negro colleges in 1932; the largest number of courses begun in any one year were instituted in 1936 and the nineteen courses as indicated were organized within a period of six years from 1932–1938. Of the schools included in this study, Miner Teachers College, Washington, D. C., was the first to introduce a survey course in science, having done so in 1932.

The reason or reasons given by the different schools for the establishment of

the survey courses in science are presented in the following table.

TABLE III

REASONS FOR THE ESTABLISHMENT OF THE SURVEY COURSES

Reasons	Frequency
There was a felt need	14
It is in keeping with the General Education Movement (Junior College Movement)	8
It was established because of certain textbooks	1
It was established to give the students of (name of a certain school) a broad and comprehensive knowledge of the Arts and the Sciences	1
A general course for elementary school teachers	1

It seems that no state in which the schools included in the study are located at present have these courses as state requirements for no school checked this item as a reason for the establishment of the course. The reason most frequently given for instituting the course is "a felt need," being given by 14 schools; and the next reason in point of frequency of mention is that "it is in keeping with the General Education Movement (Junior College Movement)," 8 schools so indicating. The influence of certain textbooks seems to be negligible for only one school indicated that it was so influenced.

The following table gives the objectives of the survey courses with the frequency of mention by the different schools.

TABLE IV

OBJECTIVES OF THE SURVEY COURSES IN SCIENCE

Objectives	Frequency
1. To teach students to appreciate the role science plays in modern life	15
2. To give the student a general knowledge of the subject matter of science	14
3. To integrate the various fields of science	13
4. To help students to understand the environment	12
5. To serve as an introduction enabling the selection of regular science courses	12
6. To give the student an appreciation of the scientific attitudes	12
7. To provide the student with sufficient scientific background for his cultural development	12
8. To acquaint the student with the main generalizations of science	11
9. To show the student the influence of science as an element of civilization	10
10. To lay the basis for a balanced philosophy of life	9
11. To acquaint the student with the points of view of science	9
12. To teach students that by the organization of knowledge man gains increasing control of environment	8
13. To help students to understand the scientific method	7
14. To gain a knowledge of the leading scientists and their contributions	7
15. To aid the student in better understanding later courses in the curriculum	6
16. To teach students to use scientific languages with exactness	6
17. To free the student from unfounded beliefs	6
18. To learn to solve problems in life situations	5
19. To fulfill a curriculum requirement of a certain amount of science	3
20. To teach students to find additional science material	3
21. To prepare the student for the teaching of General Science in the high school	2

The objective most often given for the survey course in science is "to teach students to appreciate the role science plays in modern life," having a frequency of 15 and a rank of 1, and the one least often given is "to prepare the student for the teaching of general science in the high school," which has a frequency of 2 and a rank of 21.

In a similar study of 144 institutions offering survey courses in science, Winokur [1] found that the ten objectives most

[1] Morris Winokur. "A Survey of Generalized-Science Courses in Institutions of Higher Learning." *Science Education* 20: 132–140; October, 1936.

frequently given for the courses, for which I have determined the rank, are:

Objectives	Rank: Winokur	Rank: Present Study
To give the student a general knowledge of the subject matter of science	1	2
To acquaint the student with the generalizations of science	2	8
To learn to understand the environment	3	5.5
To serve as an introduction enabling the selection of regular science courses	4	5.5
To understand scientific method	5.5	13.5
To give the student an appreciation of the scientific attitudes	5.5	5.5
To correlate the various fields of science	7	3
To acquaint the student with the technique of science	8.5	10.5
To show the student the influence of science as an element in civilization	8.5	9
To provide the content for the teaching of general science	10	21

From the ranks of objectives found by Winokur, and the ranks of objectives that the present study show, considerable differences may be seen in five objectives:

Objectives	Rank: Winokur	Rank: Present Study
To teach students to appreciate the role science plays in modern life	11.5	1
To correlate the various fields of science	7	3
To acquaint the student with the generalizations of science	2	8
To serve as an introduction enabling the selection of regular science courses	5.5	13.5
To provide the content for the teaching of general science	10	21

In the opinion of the surveyor, if the purpose of the general survey courses is to lay a broad, general background which will assist a person in living, much more emphasis might well be given to acquainting students with the main generalizations of science, inculcating the scientific attitudes, developing use of the scientific method, learning to solve problems in life situations, laying a basis for a balanced philosophy of life, and freeing the student from unfounded beliefs.

The area of human activities is a social one and individuals must so direct their activities that they may effectively participate in the social process. Whatever our standards of value may be, they are the products of intuition tested out by experiences, which constitute the basis on which individuals formulate certain generalizations which act as motivating factors in their lives. A "truth" of science is true and just as much so in the hands of one individual as in the hands of another and while the sciences, in and of themselves, are really not the sources of standards of value, the findings of science afford the best material from which to derive standards of value, and the process of evaluation or derivation of values is unique, over and above that of science; it is philosophical and not scientific. It would seem, then, that "laying a basis for a balanced philosophy of life" should have peculiar significance for the survey courses in science, as should "learning to solve problems in life situations." Feeling is the ultimate indicator of all value; therefore the value of an activity lies in the consequences to the self. It is then the basic feelings of pleasantness, unpleasantness, excitement, and depression, and emotions built up from these feelings plus perceived relations of the individual to some situation which determine the disposition or attitude that an individual will assume toward situations which he comprehends and which involve an emotional reaction for or against the conditions inherent in the situation.

It is the extent to which an individual is able to control his future behavior in terms of the feelings and emotions that such behavior arouses in him, and in terms

of the effect that such behavior will have on society, that is considered worthwhile. The art of living in cooperation with others is of paramount importance and the degree to which an individual reflects on his past experiences, the kinds of attitudes he acquires, and the methods of inquiry that he brings to bear on a situation determine how effective he will be in this art. The program of general education is to be justified in so far as it assists a person in doing these things. That the main emphasis should be on developing a functional understanding of the major generalizations of science, inculcating the scientific attitudes, stimulating the use of the elements of the scientific method, laying a basis for a sound philosophy of life, learning to solve problems in life situations, and freeing students from unfounded beliefs would seem to be in keeping with such a program of general education and should be emphasized accordingly.

Thirteen institutions indicate that the students are divided into sections; 5 state that they are sectioned on the basis of random sampling; 2 according to the type of curriculum pursued; 2 according to major interest or subject; and one each according to mental tests and minor subject. From the rather wide range of students per section, one might venture the conjecture that in all probability schools section students to accommodate their schedules and not because of some set standard of number per section. The table following shows the frequency of the number of students per section.

TABLE V

NUMBER OF STUDENTS PER SECTION

Number of students per section	Frequency
20–24	1
25–29	2
30–34	3
35–39	0
40–44	1
45–49	0
50–54	3
50–100	1

Approximately 1,650 students were enrolled in survey courses in science this past year.

Eight of the schools schedule the class meetings for three hours per week; 4, for four hours; 3, for five hours; and 3, for six hours per week.

Eleven courses are offered for two semesters and two for one semester; four are offered for three quarters and two for two quarters. One school, a normal and industrial school, devoted twelve semester hours of credit to the survey courses in science, six semester hours each being given to the Survey of the Biological Sciences and the Survey of the Physical Sciences. Twelve schools give 6 semester hours of credit to the course; 3, eight semester hours of credit; 2, three semester hours of credit; and one school has a no credit system.

TABLE VI

ELECTION OF COURSES

Election of courses	Frequency
Elective for freshmen	4
Required for freshmen	11
Elective for sophomores	1
Required for sophomores	4
Required for all students for graduation	3
Elective for students majoring in science	2
Required for students majoring in science	2
Elective for students minoring in science	1
Required for students minoring in science	1
Elective for students not majoring in science	3
Required for students not majoring in science	5

In addition to the types of electives given above, one school states that the course is required of all students majoring in fields other than science, or mathematics, or home economics, or agriculture, or industrial arts; another school requires a year course in the Survey of the Biological Sciences for freshmen, and a year course in the Survey of the Physical Sciences for

sophomores; a third school indicates that the course is taken mainly by freshmen and that transfer (A.B.) students who do not have a year of science may elect it; a fourth states that the course is required of all students except those who elect the home economics curriculum; a fifth school is interesting in that at present the course is elective for all students in the Arts and Science Division of the college; and two schools require an examination for transfer students from other schools who show credit for equivalent work in science.

TABLE VII

THE NUMBER OF COURSES OFFERING SUBJECT MATTER FROM THE FOLLOWING FIELDS INDICATED

Subject matter fields	Frequency
General Botany	18
Physics	18
Chemistry	18
Physiology	17
General Zoology	16
Astronomy	16
Geology	15
Health	13
Genetics	13
Eugenics	12
Bacteriology	11
Anthropology	8
Psychology	8
Photography	1
Nature Study	1
A little Archeology	1
Meteorology	1

From the above table, photography, nature study, archeology, and meterology are certain innovations that mark a point of departure from the traditional subject matter areas as chemistry, physics, botany, zoology, geology, astronomy, and so forth. Psychology and anthropology seem to be favored by some as sciences to be included in the survey courses.

Relative to the technique used in organizing the courses, 78 per cent of the schools state that the courses were formulated by a committee and 22 per cent indicate that the courses were formulated by an individual.

TABLE VIII

VARIOUS TYPES OF ORGANIZATION OF THE COURSES

Organization of the course	Frequency
1. The course uses with slight modification the form of organization of subject matter found in the separate fields like botany, zoology, etc.	4
2. The course uses a small number of topics or principles as a framework with subject matter pertaining to them drawn from different fields	7
3. The course is organized on the basis of relationships that exist between:	
a. Facts and generalizations of pure science	1
b. Pure science and applied science	7
c. Science and philosophy, religion, morals, economics, politics, and other aspects of human life	5
4. The course is descriptive in nature presenting information without much attempt to show relationships	1
5. The course consists of a series of units based on a historical development of the sciences	2

Havighurst[1] indicates that science survey courses fall into four classes: comprehensive, selective, analytical, and descriptive. In general the comprehensive type of course is described in 1 above, the selective type in 2, the analytical type in 3, and the descriptive type in 4; number 5 emphasizes the historical development of the sciences. From an analysis of the catalogs of 64 liberal arts colleges for the year 1935–1936, Havighurst found that the majority of survey courses were comprehensive courses. The present study finds that in most Negro colleges and universities, the selective type of course is in favor. Many of the schools also use some of the relationships included under 3, when the course is organized as a selective course.

One school that checked number one uses in addition, with slight modifications (b) and (c) under three and has a series of units under (5) on certain practical relationships. Another school has the work

[1] Robert J. Havighurst. "Survey Courses in the Natural Sciences." *The American Physics Teacher* 3:97–101; September, 1935.

organized as in (a), (b), and (c) under three and includes somewhat (5).

As for the methods of presentation, no school uses lectures or classroom discussions exclusively; the predominant method of presentation is a combination of the lecture and discussion methods which 15 schools state they use exclusively. There is a wide range and diversity of apportionment of the approximate amount of time allotted to lectures and discussions as shown in the following table.

TABLE IX

PER CENT OF TIME DEVOTED TO LECTURES AND DISCUSSION

Per cent of time devoted to lectures and discussion	Frequency
L 75 / D 25	4
L 60 / D 40	3
L 50 / D 50	2
L 40 / D 60	1
L 30 / D 70	1
L 65 / D 35	1
L 30 / D 60	2
L 60 / D 30	1
L 70 / D 30	1
L 20 / D 80	1

Ten schools state that individual conferences are scheduled and four state that individual laboratory work is required; one school indicated that six weeks of individual laboratory work is required per semester, while another requires four hours per week throughout the semester. Generally laboratory work takes the form of demonstration experiments, 17 schools indicating that this method is used; in only two instances are demonstration experiments performed by students; while 14 schools state that demonstration experiments are performed by teachers and seven by both teachers and students. In one instance we find that specialists are invited in to conduct lectures and discussions, and another school states that the methods used differ in different sections of the same course, of which there are three. Eight schools indicate that the whole course is taught by one person and an equal number state that different phases of the course such as botany, zoology, physiology, physics, chemistry, and so forth are taught by different teachers.

The following table will suggest the extent to which certain teaching aids are used in connection with the course.

TABLE X

TEACHING AIDS

Teaching aids	Frequency
Models	16
Museum specimen	15
Charts	16
Lantern slides	14
Film strips	6
Silent motion pictures	8
Sound motion pictures	9

Two schools maintain a museum where experiments are so set up that they may be performed by students in a few minutes. Ten schools state that field trips are made in connection with the course.

In determining the extent to which a comprehensive examination over the survey course is used as a means of both evaluating the student's work and as a means of admitting the student to advanced standing, the following table shows that ten or approximately 52 per cent of the schools require these examinations, while in no case is such an examination used as the sole basis for a final grade for the course. Approximately the same percentage of schools that require a comprehensive examination require that a comprehensive examination be taken before being admitted to junior standing or to the major division or the senior college.

TABLE XI

USE OF COMPREHENSIVE EXAMINATIONS

Use made of comprehensive examinations over the whole course	Frequency
1. Required	10
2. Not required	5
3. Taken on certain specified dates	8
4. Taken when the student feels that he is ready to take it	0
5. Required before being admitted to junior standing or to the major division or the senior college	10
6. Required for transfer students before being admitted to junior standing	2
7. The sole basis for a final grade for the course	0
8. Given to transfer students from other schools who feel that their background in science is sufficient to warrant their taking the examination without having taken the survey course	2

Approximately ten per cent of the schools require such an examination for transfer students before being admitted to junior standing and only ten per cent of the schools seemingly are liberal enough to give such an examination to transfer students from other schools who feel that their background in science is sufficient to warrant their taking the examination without having taken the survey course.

In answer to the question of the use of a syllabus in the course, nine schools or approximately 47 per cent of the schools answered in the affirmative. Generally in such cases the syllabus used was formulated by the members of the regular staff. Eleven or approximately 58 per cent state that a basic textbook is used in the course and only one school indicates that the syllabus is used in conjunction with the basic textbook. Approximately 68 per cent of the schools require special references in addition to the textbook or syllabus.

Of the persons who offered instruction in these courses during the year 1938–1939 approximately 24 per cent held a doctor's degree, 73 per cent a master's degree and three per cent the bachelor's degree. From the degrees held by these instructors it would seem that their preparation is adequate to give instruction at the junior college level. Many of the teachers with master's degrees have one or more years of graduate work beyond that degree and are working on their doctorates.

In considering the professional rank of these teachers, 17 or 48 per cent have the rank of professor; nine or 26 per cent the rank of instructor; six or 17 per cent, the rank of assistant professor; and three or approximately nine per cent have the rank of associate professor.

Twenty-one teachers have had high school teaching experience; the modal number being seven with two years of experience. The number of years of high school teaching experience ranges from one to nine years.

Thirteen teachers have had experience in teaching in junior colleges, the range in years being from one to seventeen. In general the majority of them have had from one to six years of experience; and three have had from fourteen to seventeen years of experience. The teachers seem to group themselves at the two extremes of the range having either from one to six years of experience or from fourteen to seventeen years of experience.

TABLE XII

PROFESSIONAL TRAINING IN EDUCATION

Number of semester hours	Frequency
0*– 4	9
5– 9	2
10–14	2
15–19	6
20–24	4
25–29	4
30–34	5
35–39	0
40–44	2
45–49	1
50–54	1

* Six teachers have had no professional training in Education.

It is seen that all of the teachers with the exception of six have had some training

in professional courses in Education and of the 30 who have had such training the number of semester hours of work taken ranges from three semester hours to fifty semester hours.

The number of years of experience in teaching survey courses in science that these teachers have had ranges from one to eleven, with the modal number being four years. Twenty-six have had from one to four years of experience and ten from five to eleven years. No doubt the teachers who have had from ten to eleven years of experience in checking this item referred to the course in general college biology which has been taught for many years on the college level.

These teachers have had from one to seven years of experience in teaching the particular survey course in science that they taught this past year. Twenty-four or two thirds of the teachers have had from one to three years of experience with the courses that they taught during the year 1938–1939, while twelve or one third of the teachers have had from four to seven years of experience with the course taught this past year. It is readily seen that the majority of the teachers have had from one to three years of experience in teaching the courses that were taught this past year. Eighteen of these teachers have been members of their present faculties from one to four years; sixteen, from seven to eleven years; one, thirteen years; and two, from sixteen or seventeen years.

The following tables list what the teachers of these survey courses in science consider as the advantages and disadvantages of the courses as now taught.

TABLE XIII

DISADVANTAGES OF THE SURVEY COURSES IN SCIENCE

Disadvantages	Frequency
1. It is at a disadvantage because of the difficulty in finding teachers well-trained or well-versed in the subject matter of more than one subject field and more than one subject area	17
2. It is superficial in treatment of subject matter	16
3. It lacks uniformity in grading and examining when more than one professor conducts the course	15
4. It disregards the disciplinary value of scholarly work in science	10
5. It causes the student to become unscrupulous in grasping at conclusions and puts a premium on shallow generalizations	9
6. It engenders a distaste for details	7
7. It causes competitive major-seeking by some of the departments	5
8. It is at a disadvantage because of a lack of interest on the part of professors offering the course	5
9. It does not take sufficient account of individual difference because of the planned nature of the course	5
10. It does not take sufficient account of the amount that students can assimilate if pressed	4
11. It develops an impatience with the drudgery of scholarship	3
12. It lacks the cooperation between the different professors conducting the course	3
13. It is at a disadvantage because of difficulty of getting concrete learning experiences	5
14. It is at a disadvantage because of the difficulty of fitting laboratory work into the course	2
15. It is at a disadvantage because of the difficulty of obtaining desirable texts which should integrate the course objectives, present the subject matter as a continuous whole, and emphasize the essential facts and principles	2
16. It is at a disadvantage because of cost of equipment	1
17. It is at a disadvantage because of lack of equipment	1
18. It is at a disadvantage because routine laboratory work is essential to the mastery of any science	1
19. It is at a disadvantage because of the difficulty in the presentation of the course offerings so as to hold the student's interest who may not plan to pursue the natural sciences beyond the level of this general course	1

TABLE XIV

ADVANTAGES OF THE SURVEY COURSES IN SCIENCE

Advantages	Frequency
1. It helps students secure a comprehensive knowledge of the natural sciences	28

Advantages	Frequency
2. It helps students secure an integrated and humanized understanding of the natural sciences	28
3. It exposes the students to many sciences which may help them to make a wise vocational choice	23
4. It develops the survey habit, "seeing things whole"	19
5. It makes the requirements of science appear more reasonable to the average student	15
6. It improves the quality of regular introductory courses in the special fields of science by relieving them of "requirement meters"	13
7. It allows the students to come in contact with the more mature members of the faculty of wide experience	6
8. It supplies some needed information for intelligent daily living	1
9. It enables students to read current literature with partial understanding	1
10. It has the advantage of more than one lecturer each of whom has done special work in his field	1
11. It teaches the concepts and terms of scientific language as well as the scientific method	1
12. It prepares teachers (elementary) to help boys and girls answer their own questions in the field of science	1
13. It destroys false preconceptions before those who are not going to specialize in the sciences have finished college	1
14. It serves as a means of developing a favorable attitude toward science courses; *i.e.*, it motivates and erases the average high-school graduate's idea that sciences are stiff	1
15. It serves as a preparation for those students who plan to concentrate (specialize) in some branch (department) of the natural sciences	1
16. It should serve as a basic introductory course in the methods of skills of the natural sciences	1
17. It should afford an opportunity for students to pursue a more intensive study in fields of special interest, and thus lead to independent study and critical thinking	1

AN IMPROVED OBSERVATION HIVE

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Apis mellifera, the familiar honey bee, has been the object of man's attention for centuries. It is one of the few directly beneficial insects, and one which because of its highly developed social life finds itself the object of study in general science, biology, zoology and entomology courses in secondary schools and colleges. The individual insect may be interesting and worthy of study as an object of high specialization, but much more valuable is the opportunity to observe the entire colony at work on its many fascinating tasks. Since the honey bee has never been tamed and has certain peculiarities of defense, there are many teachers who would hesitate to use such demonstration material, especially in the classroom. The observation hive, however, provides a comparatively simple method by which this may be done.

The ordinary observation hive, purchasable from dealers in beekeepers' supplies or the type that is generally made by the beekeeper himself, is a glass-walled hive body containing one or two brood frames and possibly a few comb honey sections above. The principal advantage of this type of observation hive is that an entire colony cannot be accommodated, and it must be considered a rather temporary affair. Reproduction is limited, and the colony may dwindle away.

Another type of hive body is found in which there is accommodation for ten brood frames, and the four walls are made of glass. The disadvantage of such a hive lies in the fact that only the outside frames may be observed, and there is comparatively little activity so near the light. Such being the case, it is usually impossible to observe such interesting activities as the forming of the wax chains, the pollen dance, and the building of the queen cells. Further, the class may not see the brood cells in their different stages, the pollen cells, or the queen herself.

The observation hive described in this article is an attempt to overcome these disadvantages, but is not without a few in itself. However, it is believed to be superior to the traditional type in that it is possible to observe all of the above mentioned activities.

For the relatively few teachers who are beekeepers, building and operating such a hive will be a simple matter. For the others, after the hive has been built by the teacher or the pupils in the school shop, two courses are open. Purchase a colony from your local beekeeper and have him install it, or immediately take up this fascinating hobby, which is much easier than might be supposed.

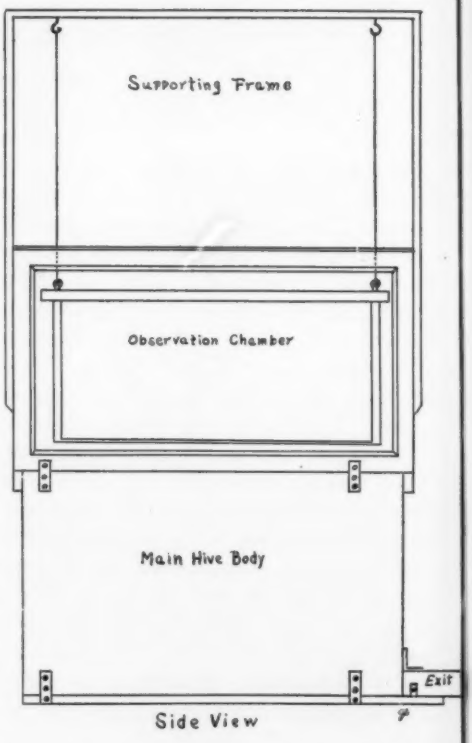
Briefly, this hive is composed of three distinct sections. On the bottom is the ordinary hive body containing the brood frames. Directly above this is a glass-sided observation chamber. The top section is simply a rack or frame to which are fastened the lifting wires when the frames have been raised into the observation hive.

An ordinary ten-frame hive body is used, fastened to the bottom board by means of a metal strip at each corner. The bottom board in turn should be fastened to the floor or bench by angle irons near the corners. It is suggested that only nine instead of ten frames be used, since the sticking of the frames due to wax deposits between them will present a problem when the frames are lifted. The hive body is not meant for observation, and very little attention need be paid it. In it the brood is raised, the honey and pollen are stored, and the other activities are carried on. It

should be kept dark and free from vibration with an exit tube to the outside air so that the bees may go about their usual business of collecting pollen and nectar.

The exit tube may be made of wood, or better still of wood with sections of glass, so that pupils may see the bees going in and out of the hive, especially when they are collecting pollen and are returning with the brightly colored substance in the pollen baskets. The main hive opening should be blocked off with wood, leaving a space of about six inches in the middle through which the bees may pass. The exit tube should be fitted snugly over this and fastened to the bottom board and the hive body with angle irons. The bottom of the tube should be made of wood, and in case the hive is to be below the level of the window opening, the slope of the tube should be gentle. The top side of the tube may be made of glass, and this should be covered with cloth or a strip of wood when observations have been completed. The window may be raised and the tube allowed to extend from it, the rest of the opening being blocked off so that bees will not be able to enter the room, or a hole may be cut through the window frame. It is an excellent idea also to place a landing platform outside the window, since heavily laden bees sometimes have difficulty in effecting a safe landing on a small space.

The observation body, which is placed directly over the hive body, should be of the same width but two inches longer than the brood chamber. This is necessary in order to facilitate the easy lifting of the brood frames. A one inch strip of wood may be fitted along the front and the rear of the brood chamber at the top to take care of the added length of the observation chamber. The two chambers should then be fastened together with a metal strip at each corner. The observation body itself should be built in the form of a frame. The two ends should be of wood, but the sides should have panes of good quality window glass fastened securely with



Side View

wooden strips. There is, of course, no bottom board, since it fits directly over the main hive body. The top should also be a solid piece, similar to the inside cover of an ordinary hive. Through this cover, which is fastened in place with wood screws along the sides and ends, there will be drilled nine holes at the front and nine at the back, spaced in such a manner and of such diameter that only wires may pass down through to connect with screw eyes which have been fastened at either end of the top of each of the brood frames. The wires will have loops in them at the top end, but they are fastened securely at the bottom. By passing the fingers through the loops of the two wires connecting with any one brood frame, that frame may be lifted up from the hive body into the observation chamber and hung on hooks above, which are fastened into the supporting rack.

The supporting rack may be a movable one which can be slid back and forth across the top of the observation body, and on to which two or three pairs of wires may be hooked. Or, it may be a third story in which there is a hook for each wire below. The latter method is perhaps the safer and the easier to operate.

The obvious disadvantage of such an observation hive is the lack of a comb honey super. From the educational point of view very little will be lost, as supers or extracting frames may be kept in the classroom and their use explained. That which actually goes on in the super might well be demonstrated from the brood frames where the unripe honey can be seen in the cells and the light colored capped-over honey cells are also to be seen. However, it is possible to demonstrate the complete process, if it is desired, by the construction of a more complicated hive in which the glass-walled super is placed on top and the observation chamber is placed at the side. It would be necessary in such an arrangement to pull or push the brood frames out horizontally into the glass-walled hive. This would entail increased expense and labor, and in addition it would be more difficult to operate. The increased advantage of seeing the comb honey sections filled would hardly warrant it. It is also possible to use such sections in the vertical lift type of hive just described by putting the sections in the observation chamber at one side where they will not interfere with the lifted brood frames. They may be removed as they are filled, or the entire observation chamber may be given over to getting a crop of honey to the exclusion of knowing what is going on within the brood chamber.

A further refinement of the apparatus would be the inclusion of a metal sheet which could be slipped through a thin slit in the wood so that the hive body might be darkened when the observation is completed. This would necessitate a different method of wires for raising the frames, as the wires would have to be unhooked before the sheet could be put in place. A simpler method perhaps would be to have the wires all pass through a sheet of metal or wood which fitted closely over the frames and acted as a cover for the hive body. When the frames were to be raised, the wooden sheet would come with it or a wire at each corner could be used to raise it first. It is doubtful that such a cover is absolutely necessary.

Once the hive as described has been installed, its care and operation is comparatively simple. The pupils and teacher are sufficiently protected from the insects, and the bees need very little care. As soon as the first skunk cabbage pokes up through the soil until the last fall flower has withered, the bees are able to feed themselves. If they are a strong colony, they will provide sufficient food for themselves for the entire winter. If the colony is weak, it will be unable to provide for itself and will undoubtedly be greatly decimated by spring unless food is provided for them. Comb honey may be placed in the observation chamber, or an opening may be cut in the wall so that a feeder can be attached. Usually the hive is wanted in the classroom only during the warm months when the bees are most active, but it is possible to make it a permanent feature. When observations are not being made, it is well to fasten panels of wood or pieces of cloth in such a manner that the interior will be kept dark.

Such a hive, although a little more complicated than the usuual type and perhaps a little more difficult to build, will be found to be well worth the trouble and an added attraction in any science classroom.

SOUND: A STUDENT TEACHER'S FIRST LESSONS

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How We Came to Study Sound.—There is not a single person who does not come in contact with a variety of sounds in the course of a single day. Nature is full of sounds, and to these have been added those which are produced by the various instruments which man has invented. An awareness and knowledge of some of these sounds constituted my purpose in teaching a unit on sound during my practice work in the Fourth, Fifth, and Sixth grades of Spring Road School at Vineland, New Jersey.

One morning I brought a set of tuning forks with me. I had hardly put these on my desk when a group of boys and girls asked, "Are those magnets?" I saw at once that they were curious and were eager to find out the name of the instruments. A group of boys immediately began to look for a picture in science books and dictionaries. The desired motivation for the unit had been attained at once. Very simple sound experiments were featured during our morning exercises. Among those were the carrying of sound vibrations through a string tied to a vibrating spoon, producing waves in water when a vibrating fork was put into it, observing that the tone produced by a short vibrating fork was much higher than that produced by a longer one, and showing that violin strings of different lengths produced different tones. These experiments provided for further motivation.

The classes decided that there were other things about which they wanted to know. Therefore, it was suggested that a composite notebook be made containing the facts concerned with sound. The making of this notebook was to be the work of a special committee selected by the class together with any additional assistance from other classmates and from the teacher.

Things We Wanted to Know.—One class period was devoted to discussing some of the things which the pupils wanted to know. Some of these questions were not spontaneous but were deduced and formulated after the pupils had observed the experiments pertaining to them. Among the things which they wanted to know were the following:

1. What is sound?
2. What things are necessary in order that sound may be produced?
3. How does sound travel?
4. In which materials does sound travel fastest?
5. Which travels faster—light or sound?
6. Under what conditions does sound travel best? (temperature)?
7. What causes echo?
8. How do we hear sound?
9. How do we get different tones from our musical instruments?

Sound Experiments.—Much of the success of the unit was due to the fact that for almost every abstract fact of importance we had a simple experiment to make it concrete. Among the experiments which were used were the following:

Problem—To find out what things are necessary for making sound.
Materials (same for all experiments): tuning fork, bell, clock, pan of water.

Problem—A vibrating object is very necessary for sound.
Method: (1) Strike a tuning fork, (2) Put the fork in water.
Observation: (1) The vibration from the tuning fork caused waves in the water, (2) When the fork stopped vibrating there were no more waves.
Result: Vibrating objects produce sound.
Use of this result: Musical instruments.

Problem 2—Force is necessary to produce vibration.
Method: (1) Apply force to the bell, (2) Let the bell stay on the desk.

Observation: The bell rang only when force was applied.
Result: Force is necessary for sound.
Use of this result: Force is necessary in order to play musical instruments.

Problem 3—Something must be able to carry sound.
Method: (1) Strike a tuning fork and hold it, (2) Strike a second time and let it vibrate.
Observation: (1) When the fork was held in the hand the vibrations were absorbed, (2) When the fork was permitted to vibrate the air carried the sound to us.
Result: Air carries sound.

Problem 4—In order to have sound we need someone to hear it.
Method: (1) First everyone in the class listened to the clock tick, (2) Next a few pupils went out in the hall.
Observation: (1) At first everyone heard the clock, (2) The people out in the hall did not hear the clock.
Result: To have sound someone must be there to hear it.

Objectives of the Unit.—The objectives which were to be attained at the completion of this unit were as follows:

1. To interpret the relation of sound to daily life.
2. To find out the necessary factors in the production of sound.
3. To become familiar with the laws of vibrating strings, namely,
   (a) The sound as affected by length.
   (b) The sound as affected by tension.
   (c) The sound as affected by diameter.
4. To understand the production of sound by vibrating air column, and comparing it with the laws of vibrating strings.
5. To find out how sound is produced by percussion instruments.
6. To study musical instruments using the laws of sound production which have been learned.
7. To find out how sound is produced by the human voice.
8. To learn the important parts of the ear and how we hear sound.
9. To find out the meaning of echo and the conditions necessary for its production.

Applications of Sound Discussed.—During our class discussions, we found that the things which we had been talking about surrounded us on every hand. For example, we made the following list of things which produce sound:

1. Talking
2. Birds
3. Bells
4. Musical instruments
   a. radio
   b. piano
   c. [illegible]
   d. violin
   e. horn
   f. phonograph
   g. bugle
   h. saxaphone
   i. drum
   j. cymbals
   k. clarinet
   l. cornet
   m. harmonica
5. Cars—trucks
6. Wind
7. Horns
8. Volcanoes
9. Rain
10. Thunder
11. Trees
12. Hail
13. Whistles
14. Saw
15. Doors
16. Skates, Ice and Roller
17. Airplanes
18. Lockers
19. Clocks
20. Watches
21. Vacuum cleaners
22. Water
23. Heart
24. Fire
25. Telegraphs
26. Telephones
27. Glass
28. Chairs
29. Mosquitoes
30. Butterflies
31. Frogs and toads
32. Typewriters
33. Movies
34. Earthquakes

Perhaps our greatest applications of sound was that of musical instruments. Each instrument is classed according to the way in which the sound is produced:

Wind instruments

1. Accordion
2. Cornet
3. Bugle
4. Fife
5. Clarinet
6. Ocarina
7. Harmonica
8. Trumpet
9. Oboe
10. Trombone
11. Organ
12. Saxophone

Percussion instruments

1. Drums
2. Xylophone
3. Cymbals
4. Bells
5. Triangle
6. Gong

String instruments

1. Violin
2. Violin cello
3. Bass viol
4. Harp
5. Guitar
6. Mandolin

Vocabulary.—During our study of sound, the learning of new words gave added meaning to our facts and concepts. The following definitions were formulated by the pupils with my help:

Tuning Fork—a vibrating instrument.
Vibration—A back and forth motion causing sound.
Velocity—Speed.
Sonometer—An instrument which records sound vibrations.

Rare—The wave particles are far apart—"rare factions."
Dense—The wave particles are close together —condensations.
Density—The number of molecules in a given space
Frequency—The number of vibrations per second.
Percussion Instruments—Those instruments played by hitting.
Glottis—A small opening in the throat.
Larynx—The voice box or Adam's apple.
Auditory Nerve—The nerve which carries sound impulses to the brain.
Eustachian Tube—The air tube which leads from the mouth to the ear.
Intensity—The amount of force with which particles move in a wave.
Loudness—The ease with which a sound is heard.
Pitch—The quality of sound determined by vibrations.

Learnings.—The following learnings resulted from our unit:

1. Things necessary for making sound.
   a. anything which will make sound (vibrate)
   b. Force
   c. Air—anything that is able to carry sound
   d. Somebody to hear the sound

2. Percussion Instruments with definite pitch.
   a. Bells
   b. Triangle
   c. Xylophone

3. Things which determine the kind of sound made by a drum.
   a. Tightness of skin
   b. Size of drum
   c. Force with which it is struck

4. Making sound with wind instruments.
   a. A short air column produces a high tone
   b. A long air column produces a low tone
   c. A small diameter gives a higher tone than a large one
   d. Keys are used to change the length of the air column
   e. The reed in reed instruments helps to produce a tone

5. Hearing Sound.

There are three parts of the ear: outer ear, middle ear, and inner ear. When some one speaks to you, if the waves are rare the waves give your ear a light tap. But when the waves are dense the waves give you a heavier tap.

When the sound comes to your ear, it strikes the ear drum causing it to vibrate. A bone called the hammer is attached to the bottom of the ear drum. When the ear vibrates it causes the hammer to shake. The anvil is attached to the hammer, vibrates when the hammer shakes. The stirrup is attached to the anvil and it vibrates when the anvil shakes.

In the inner ear is a fluid through which the waves travel, if the wave is a dense wave the fluid moves faster.

When the fluid goes through the spiral coil it moves faster.

The auditory nerve system goes to the brain that translates the dots and dashes.

Take Care of your Ear: 1. Use a soft cloth to wash your ear, 2. Don't blow anything in the ear, 3. Don't put anything in your ear, 4. Don't make a loud noise in somebody's ear.

6. Hearing Ourselves Talk.
   a. Echo is the bouncing back of sound
   b. When do we have echo?
      (1) If a place is quiet
      (2) When there is no material to absorb the sound
      (3) When we have a reflecting surface
         (a) Walls of a room
         (b) Buildings
         (c) Trees
         (d) A mountain
         (e) Ground
         (f) Air of different density
         (g) Clouds
      (4) The reflecting surface must be at least 55 feet away.
   c. When we will not have an echo
      (1) When there is no reflecting surface
      (2) When there is material that will absorb sound.
      (3) You have no echo when the ceiling is irregular.
      (4) When the reflecting surface is not 55 feet away

7. Knowing the Voice.
   a. Use of the voice
      (1) Talking
      (2) Singing
      (3) Whistling
   b. How sounds are made
      (1) Voice box—Adam's Apple—Larynx—Vocal Cords
      (2) Small opening—Glottis
      (3) Air makes vocal cords vibrate
      (4) Tongue
      (5) Lungs—supply of air
      (6) Nose helps to make the sound clearer
      (7) Teeth
   c. How different sounds are made
      (1) Sound is produced by expiring air
      (2) Muscles make the vocal cords shorter or longer
      (3) Speed of air, passing over cords
      (4) Small opening of glottis—higher tone
      (5) Large opening—low tone
   d. Why voice changes when person gets older
      (1) Because Adam's Apple gets larger and the vocal cords get longer

e. Why do girls have higher voices
   (1) Because they have smaller Adam's Apple
   (2) The vocal cords are shorter
f. Why do some men have higher voices
   (1) More practice
   (2) It was born in them
g. How can we whistle
   (1) Small opening of your lips—high sound
   (2) Large opening of your lips—low sound

8. The Story of Stradivari.

When Antonio Stradivari died on December 18, 1737, he was more than 90 years old.

He had made more than a thousand musical instruments, the chief one was violins.

The secret of making this varnish, with its growing colors of orange or red, has never been discovered.

On exhibition in the library of Congress in Washington, D. C., is a valuable collection of Stradivari instruments, including three violins, a viola, which is larger than a violin.

Editorials and Educational News

THE SCIENCE TEACHING OF TOMORROW

Give a young child an expensive gold watch and a ten-cent tin one and he will make no distinction between them. Both will soon be battered to pieces with great energy and delight. The child has no sense of relative values. He is also determined to find out why one watch ticks and the other does not. His innate curiosity rules out all other tendencies. The child is, indeed, father to the man who has always desired to discover how things are put together and how they work.

Our earliest ancestors were experts at destruction, but short on creation. They were at all times completely at the mercy of their environment. They feared the elements. They were terror-stricken at every powerful manifestation of Nature. They had no idea of the relation between cause and effect. They were ruled by superstitions.

However, the time did come when man began to use his natural curiosity for definite ends. He began to see relations between things. Once he developed the lever, the inclined plane, the wheel and axle and the pulley his rapid progress began. It was a long leap from Archimedes to the Renaissance, but the fruits of the search after truth which took place between this man and this period were the pyramids and the ox-cart on the one hand and the electric locomotive and the Empire State building on the other.

What the science of tomorrow will be no one dare prophesy. The present New York Fair: The World of Tomorrow gives one some hints of it.

We may be sure that it will exceed the wildest dreams of our imagination. The pure scientists will discover new laws and new principles which govern and shape our universe from microbes to the Milky Way. And all will have been the result of the growth of the faculty and ability to make comparisons and reach judgments. These two abilities have developed with extreme slowness throughout the ages. They have come to stay and to grow.

It is interesting to know that this advance was first summed up in a man who lived three hundred years before the Christian era. Aristotle was the first man to recognize the validity of logical thought processes based upon actual and accurate observations. He pointed the way for all time to a new, distinct and proper use of the mind in thinking about anything. This man observed, observed and then observed again. His one great fault was that he did not experiment.

Following him for two thousand years scientific thought was at a standstill while theologians debated and laymen took for granted that a horse had canine teeth and man had an odd number of ribs, since one had been removed to form woman. No one dared to look into a horse's mouth or count his own ribs in the privacy of the boudoir. That would have been heretical, vulgar and sacrilegious.

And then came Copernicus who observed the heavens with a quaking heart and a reverent mind. Galileo, that great Florentine, followed him and refused absolutely to believe anything simply because someone in authority had declared it to be true. Determined to find out things for himself, this man not only accurately observed but he also experimented. Through him was the true and modern spirit of scientific thinking born and nurtured.

It was with a spirit of humility that I stood some few years ago in the cathedral at Pisa and looked at the lamp which is reputed to be the same one that gave Galileo his ideas of the laws of the pendulum. It was with a spirit of elation that I climbed the many steps of the leaning tower of Pisa and from its top dropped, as he did, two objects of unequal mass and weight at the same instant, to prove his contention regarding the laws of falling bodies. I tried to realize to some extent his spirit of adventure, his determined search after truth and his courage to face persecution, probable exile and possible death.

Threatened, he serenely went his way confident that his ideas would prevail. And so they have. Toricelli, Newton, Priestley, Lavoisior, Faraday, Tyndall, Darwin, Lister, Pasteur and all of our modern scientists are bringing us out into the white light of scientific truth. With these shining examples of truth for truth's sake before us, what shall be the kind of science we shall teach our boys and girls today and tomorrow?

Few boys and girls of our secondary schools will enter the fields of pure science through the doors of our technical schools. Most will step directly into the work-a-day world to fight the battles of existence. What kind of science should be taught these boys and girls? What kind of science were you taught? What kind of science are your children being taught today? Is it the kind of science you want them taught? Is it the kind that inspired Galileo, Darwin, Lister and Pasteur and made them apostles of truth and right living? If this is not the kind of science they are being taught they are not getting what they ought to have. They are entitled to a science which motivates them to want to develop right methods of thinking, a wholesome attitude to the problems and a full appreciation of the verities of life.

The content of general science, biology, physics and chemistry and allied sciences lends itself admirably to the attainment of these ends in the hands of expert and wise and right-minded teachers. These sciences will, when properly handled, open the eyes of our youth to the wonders and mysteries of Nature, reveal the romance of the commonplace, and set before them the ideals of truth and discipline as life guides. Such was the science of Galileo and Pasteur. Such is the science of Compton, Jeans, Millikan and Einstein.

Every new science text is stuffed full of facts. But what about principles? What about the proper methods of thinking about these facts and principles? Hardly a text in any science today gives 25 per cent of its pages to discussion of principles. Again we may ask: What shall be the content of the science teaching of tomorrow? The answer may well be: It will be composed of facts but only enough facts to make it possible to understand principles based upon these facts.

To illustrate. The observations and experiments of Galileo involved a method. There is a best method of doing anything, even washing dishes or cultivating a garden. And that best method is the scientific method. Old stuff we may retort. Yes, but is it? For the sake of simplicity we may say that this method is the solution of any problem in a logical and commonsense manner. We all use this method imperfectly. The boy who makes a kite or the girl who bakes a cake faces a problem and must use a method to solve it. Success or failure depends upon the understanding of the problem and the thoroughness with which its steps are carried out. A successful solution encourages to greater effort. A failure brings discouragement and loss of further effort.

The science of tomorrow will stress this process of scientific thinking and the universal use of the experimental method. Steps in the process of solving problems will not be overlooked. Youth will be

trained to check back for errors or omissions. It will train our boys and girls to recognize consciously each step and then make them so skilled in their use that they will be followed unconsciously in the solution of everyday problems. Youth will make fewer errors, register many more successes. These should make for greater happiness and contentment.

Then again, the science of tomorrow will place much less stress upon text-books and more emphasis upon the things that the text or the immediate situation suggests as worth doing. Processes of thought will be set up which will take critical note of every step in experimental work. A reflective turn of mind will be developed. Reflective thinking and dissociation of ideas will be the chief method of mind activity. Embryonic criminals may take thought for the morrow. Such books as *"100,000,000 Guinea Pigs* will have few sales, good as they are. Patent medicine companies and quacks will go out of business.

And this is not all. Reflective thinking will prevent boys and girls from coming to half-baked conclusions. Healthy and sane discussions regarding the truth or falsity of hear-say, tale-bearing and propaganda of every sort will be developed. Better reflective thinking will sharpen judgment and steer millions from gold bricks, watered stocks, get-rich-quick schemes, chain letters, fortune tellers, lottery gambles, sweepstakes, and chewing the bitter cud of reflection.

Still again, the science of tomorrow will lead our youth to keep their minds open to the truth. It should also encourage the development of a tolerant attitude towards the opinions of others who are honestly seeking the truth. This attitude has characterized our greatest scientists and made them almost without exception reverent men.

And finally, the science of tomorrow will stress the importance of the recognition of the truth and the significance of the law of cause and effect. Every cause has its effect and every effect its cause. Once this great concept lays hold of the minds of our youth, common superstitions, so prevalent even among people who ought to know better, will be a thing of the past. Common sense sees no relation between walking under a ladder and bad luck or between finding a horseshoe and good luck. Science rules both out of our minds. Yet because we have had insufficient training in the scientific method too many people have a sneaking suspicion that there must be something in it.

And what shall the final outcomes of the teaching of the science of tomorrow be? Simply this: Each man and woman it is hoped will have developed a sound philosophy of life that will carry him or her through the thick and thin, through the happiness and despair of a victorious life.

It is perhaps unfortunate that so many people today place too little confidence in the efficacy of religious beliefs. Why not let science be their religion? Since both theologians and scientists seek the truth, the scientific method of thinking will lead both nearer the truth. Both will recognize universal law which is as immutable as the stars in their courses and which implies an Intelligence that can make natural laws and enforce them. This philosophy of life will drive out fear and will encourage the individual to conserve his own life and the life of others.

This kind of science of tomorrow must be for all the people if the mental life of all our people is to be kept sane, sweet and wholesome. And it will be the Science of Tomorrow if the search after truth is relentlessly followed by our best teachers of science. This kind of a search has harmed no man and is the promise of the World of Tomorrow.

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PRACTICAL EDUCATION FOR DEMOCRACY

A constant, affirmative emphasis on democracy in all its essentials and implications is the keynote of educational thinking today. Facing the challence of totalitarian systems with their spawn of race, religious, and class hatred, American educators are conscious as never before of the necessity of definite action within the schools to counteract the rising tide of intolerance. Teachers who are looking for help in this imperative task should know the work of the Service Bureau for Intercultural Education. It offers a positive curricular approach to the problem of intergroup prejudice, expert service where friction threatens, and practical aids for the classroom teacher, based on fifteen years' study and experimentation.

The Service Bureau for Intercultural Education fosters understanding and appreciation among the many ethnic and culture groups that compose the population of the United States. Its methods have been successfully used in more than fifty public schools in all parts of the country, with widely different problems. It collects and publishes facts on all culture groups, and its research material formed the basis for the highly successful radio series, "Americans All—Immigrants All" broadcasts on Sundays in 1938–9 by the United States Office of Education in cooperation with the Columbia Broadcasting System. Permanent recordings as well as scripts of the broadcasts are available from the United States Department of the Interior, Office of Education, Washington, D. C.

Among its direct services are Teachers' Manuals on Intercultural Education at primary, elementary, and junior and senior high school levels; one hundred classroom units designed to be used in various high school departments, containing suggestions for class activities and assembly programs. Field service is available by special arrangement. Courses for teachers and community leaders have been conducted by the Service Bureau staff at Columbia University, New York University, Temple University, Boston University, the University of California, and for the Board of Education of the City of New York. This coming year courses will be given for the Board of Education of New York City and at New York University.

Send for publications list, prices, and full information to the Service Bureau for Intercultural Education, 300 Fourth Avenue, New York City.

AMERICAN EDUCATION WEEK 1939

The 1939 American Education Week observance will be held November 6–11, 1939. "Education for the American Way of Life" is the general theme. As in previous years the National Education Association has prepared materials to assist schools in planning for this observance including colorful posters, leaflets, stickers, and packets containing special folders for the different school levels prepared by field committees in various sections of the United States. Useful alike to the classroom teacher, principal, superintendent, or American Education Week committee. Early planning will help you make your observance most effective. For complete information, write to the National Education Association, 1201 Sixteenth Street, N.W., Washington, D. C.

Abstracts

SYMPOSIUM. "Science Education." *Education* 59: 385–447; March, 1939.

This is a Science-Education number in which twenty-three specialists engaged in the various phases of science teaching have contributed. In each article, the writer tells specifically what his daily activities and responsibilities are. Not that any contributor wishes to set himself up as a "perfect example of a science educator" but rather with the idea of informing others regarding requirements of his particular field of interest. Each article, then, is vocational in nature. Each author carries this idea one step farther by specifying what he considers essential in a program of training for young teachers who aspire to work in a similar position. The following is a list of authors and titles of the articles which they have contributed:

Webb, Hanor A. *The Duties of Science Educators. An Editorial.*
Cahoon, G. P. *A Professor of Science Education in a State University.*
Thomas, W. Stephen. *A Director of Science Education in a Large Museum.*
Zechiel, A. N. *A Coordinator of Science Instruction in Experimental Schools.*
Green, George R. *A Professor of Nature Education in a College.*
Obourn, Ellsworth S. *A Teacher of Science in a Private-Progressive School.*
Curtis, Francis D. *A Director of Educational Research in Science.*
Thone, Frank. *A Science Popularizer.*
Christy, Otto B. *A Professor of Biology in a Teachers College.*
Warner, Glen W. *The Editor of a Science Journal for Teachers.*
Herndon, Thomas Corwin. *A Professor of Chemistry in a Teachers College.*
Reynolds, Charles W. *A Professor of Generalized Science in a Teachers College.*
Edwards, Kenneth B. and Busbee, H. S. *A Director of Visual Education in Science.*
Billig, Florence G. *A Critic Teacher of Science.*
Temple, Allen Porter. *A Professor of Physics in a Teachers College.*
Gay, A. Royall. *A Teacher of Physics in High School.*
Highsmith, J. Henry. *A State Director of Instruction.*
Bates, Conrad W. *A Teacher of General Science in High School.*
Platt, Robert B., III. *A Teacher of Biology in High School.*
Weaver, Elbert C. *A Teacher of Chemistry in High School.*
Wildman, Edward E. *A Science Supervisor in a Metropolitan Area.*
Rawlins, George M. *A Science Supervisor in a Large School District.*
Harner, C. A. *Educator's Responsibility Toward Democracy.*

—F.G.B.

TER KEURST, ARTHUR J. "The Acceptance of Superstitious Beliefs Among Secondary School Pupils." *Journal of Educational Research* 32: 673–685; May, 1939.

This article describes a study designed to find out whether or not the emphasis placed on the scientific method of work has affected the superstitious beliefs of children. Attention is directed toward clarifying the meaning of the term superstition; listing superstitious beliefs that seem pertinent to personality adjustment; ascertaining the prevalence of superstitious beliefs among high school students; and describing the quantitative differences in superstitious beliefs accepted by racial and sex groups. The findings of the study may be summarized as follows:

1. "In spite of our educational procedures, a large number of superstitions, were still being accepted by secondary school students."
2. The most prevalent superstitions referred "to the animistic role of nature, supernatural manifestations, and deterministic viewpoints of life."
3. "The evidence of acceptance did not decline with chronological or scholastic advances."
4. "No significant quantitative or qualitative differences in superstitiousness were found between the sex groups."
5. "Significant quantitative differences and a few qualitative differences were found in the incidence of superstitious beliefs between the white and colored children."

—F.G.B.

SYMPOSIUM. "More Demonstrations for Science Teachers." *The Science Classroom* 18: 1, 4; May, 1939.

The following demonstration techniques are presented: Shadow Projection by Paul I. Kaye; The Doppler Effect by Aaron Spector and Alexander Feldman; Humidity and Invisible Water by Alexander Feldman; A Direct Method of Demonstrating the Presence of a Vacuum in a Torricelle Barometer by Samuel B. Yacknowity.

—C.M.P.

PEATTIE, DONALD CULROSS. "Your Nature Hobby." *Natural History* 43: 69–72; February, 1939.

The author makes a plea for making nature a hobby. It is a source of friendships among the sort of people you want to know, an insurance policy against sickness or "nerves," a shield against the slings and arrows of outrageous fortune. Birds, stars, ants, butterflies, shells, flowers, microscopic life, photography, etc.—each may become an absorbing hobby.

—C.M.P.

BRADFORD, H. B. "How Animals Keep Clean." *The Grade Teacher* 56: 18, 56–57; March, This is an illustrated elementary science discussion, questions and activities.

—C.M.P.

THOMAS, KATHARINE. "Irrigation and Drainage." *The Grade Teacher* 56: 36–37, 58; March, 1939.

This illustrated unit includes objectives, approaches, development of content, completion test, activities, correlations, and bibliography.

—C.M.P.

SAWYER, EDMUND. "Signs of Wild Life in Winter." *The Grade Teacher* 56: 14–15, 69; February, 1939.

Birds and four footed animals although rarely seen in winter, leave their autographs if there is snow on the ground. Illustrated.

—C.M.P.

STAUFFER, M. K. "The Winds of March." *The Grade Teacher* 56: 32, 64–65; March, 1939.

This is a unit on the weather for the primary grades. Methods of correlating it with literature, art, music, reading, safety education, physical education, and civics, are pointed out.

—C.M.P.

PALMER, E. LAURENCE. "What's the Difference?" *Cornell Rural School Leaflet* 32: 3–31; January, 1939.

This is the first of a series of leaflets on chemistry. The first one was published in 1897, and little in the field of chemistry has been published since that time. This one is on how do we know that things differ. Taste, smell, and sight are often used, but these alone are often insufficient. Chemical and physical changes in substances are often resorted to in distinguishing substances.

—C.M.P.

SCIENCE

ZENKERT, CHARLES A. "Wild Flowers Bloom in Winter." *Hobbies* 19: 42–47; February, 1939.

The author describes, in this illustrated article, the wild flower groups of the Spaulding Hall of Conservation of the Buffalo Museum of Science. The article makes an appeal for conservation of wild flowers.

—C.M.P.

DU PUY, WILLIAM ATHERTON. "The Forests Today." *The Journal of the National Education Association* 28: 78–81; March, 1939.

America is today more "forest conservation conscious" than ever before and we are making much progress in saving our forests. Much yet remains to be done.

—C.M.P.

SYMPOSIUM. "Business." *Building America* 4: 1–32; April, 1939.

This issue discusses various aspects of business: what is business, kinds of organizations, big business, regulation of business, corporations, abuses of business, and solution of business problems.

—C.M.P.

BRYSON, H. COURTNEY. "Synthetic Plastics." *Discovery* 2: 3–7; January, 1939.

In the beginning was the Stone Age and this was followed by the Metal Age. But in the future synthetic plastics "will so increase in importance that they will be more of the nature of the fabric of civilization itself, rivalling and outclassing metal in consumption." A few improvements include: (1) Plastic-surfaced Roadways, (2) Safety glass, (3) Better Tires, (4) Artificial Wood, and (5) Paints and Lacquers.

—C.M.P.

BRYSON, H. COURTNEY. "Synthetic Plastic II." *Discovery* 2: 55–60; February, 1939.

Marked changes have occurred in man's clothing. The dress of the future will probably consist of an undergarment varying in warmth with the season—a synthetic fabric possessing a pleasing semi-matte finish. Covering this, will be an outer Greek-like costume of a glossy transparent sheet, tinted in another but harmonizing shade through which the undergarment will show in colors and shades varying with the movements of the wearer.

The house of the future will be produced from moulded or cast units, with a pleasing divergence of forms. It is not likely to be all metal, but internal fittings will be either rustless metal or moulded from a plastic. Ceramics will be out of date. Slums will be unknown and man can select his own climate by selecting his own altitude, for huge buildings two, three, or four miles high will allow individual choice of living.

—C.M.P.

LYMAN, VAN ALLEN. "Electric Shocker Extracts Venom From Snakes." *Popular Science Monthly* 134: 104–106; April, 1939.

This illustrated article describes the new, more efficient process of extracting venom from snakes by using electric shocks. Ditmars, Johnson, and other snake "milkers" use it.

—C.M.P.

JONES, H. SPENCER. "Is There Life in Other Worlds?" *Discovery* 2: 36–47; January, 1939.

This is an unusually good article by an outstanding astronomer. Possibilities of life on each of the other planets is discussed in some detail. Evidence seems to indicate that the earth is unique among the planets of our solar system in having living things. However the author concludes "it seems probable that there are other worlds where life exists though that life may be entirely different from any form of life which we are familiar." —C.M.P.

ANONYMOUS. "Mayan Diggings Shed Light on America's First Calendar." *Science News Letter* 35: 118; February 25, 1939.

Recent researches indicate that brilliant Mayan Indians actually invented a short-cut system of writing dates in the New World before the birth

of Christ. A small statuette is the oldest known dated Mayan object. It bears the date corresponding to May 16, 98 B.C.

—C.M.P.

COLTON, F. BARROWS. "The Geography of a Hurricane." *The National Geographic Magazine* 75: 529–552; April, 1939.

This illustrated article presents an unusually good description of the New England hurricane of last September 21—the causes, forces involved and the results.

—C.M.P.

DAVIS, EMILY C. "A Maze of Superstitions." *Science News Letter* 35: 138–140; March 4, 1939.

The age-old battle between enlightened medicine and superstitious "cures" is by no means at an end. We have made progress, but much more remains to be done. Many "devices" to cure illness, or to ward off disease are listed.

—C.M.P.

ANONYMOUS. "Hydrogen is Fuel of Stars and Helium is the Ash." *Science News Letter* 35: 140; March 4, 1939.

Henry Norris Russell, noted Princeton astronomer, recently declared that hydrogen was the fuel and helium the ash in the solar engine. This is true even in case of atomic disintegration of the heavier atoms—helium is the end product. The sun will continue to shine for at least ten billion years. In a hundred million years the earth's temperature may be 168 degrees instead of the present average 68 degrees.

—C.M.P.

COLBERT, EDWIN H. "Wild Dogs and Tame—Past and Present." *Natural History* 43: 90–101; February, 1939.

The dog is probably descended from the Eurasiatic wolf. Today he is considered man's best friend among the animals. An excellent chart depicting various kinds of dogs is included. Group I, Sporting Dogs—setters, pointers, retrievers, and spaniels; Group II, Hounds—scent hounds and sight hounds; Group III, Working dogs—sled, sheep, guard, and miscellaneous; Group IV, Terriers; Group V, Toy Dogs; and Group VI, Non-sporting dogs.

—C.M.P.

BARTON, D. R. "How Bright Is the Dog?" *Natural History* 43: 117–123; February, 1939.

This is a moot point, still. But the celebrated dog "Fellow" probably did more to elevate the species in the eyes of science than any other dog. He was dogdom's genius and understood about 400 English words. This is a grand dog story.

—C.M.P.

WICKER, CYRUS FRENCH. "Modern Treasure Islands." *Natural History* 43: 133–143, 171; March, 1939.

Very few people are there who do not thrill to the story of hunting buried treasure! This is such a story—seeking buried pirate gold in the Caribbean, abetted by modern scientific instruments.

—C.M.P.

WODEHOUSE, R. P. "Weeds, Waste and Hayfever; Hayfever, A Man-made Disease." *Natural History* 43: 150–163, 178; March, 1939.

The author maintains that hayfever is a man-made disease, largely preventable through soil conservation measures. Numerous, excellent photographs and a hayfever map of the United States showing predominant pollens of different regions add much to the worthwhileness of the article.

—C.M.P.

HILDEBRAND, J. R. "California's Coastal Redwood Realm." *The National Geographic Magazine* 75: 133–184; February, 1939.

This is a splendid article on one of the real natural wonders of the world—the giant redwoods of California. There are 48 photographs and illustrations, 17 in natural color.

—C.M.P.

SCHULTZ, LEONARD P. "Fishing in Pacific Coast Streams." *The National Geographic Magazine* 75: 185–212; February, 1939.

This is an illustrated article on fishes found in western Pacific Coast streams. Numerous varieties are described. There are 10 illustrations and 54 paintings in color from life.

—C.M.P.

GRAHAME, ARTHUR. "Deep-Sea Prospectors Seek Radium from the Ocean Floor." *Popular Science Monthly* 134: 51–54, 238; May, 1939.

With the aid of the longest rope in the world, a steel cable seven miles long, Dr. Piggot of the Carnegie Institution is going to seek radium at the bottom of the sea. A kind of a submarine gun operates at the end of the cable. It has been used successfully up to depths of three miles.

—C.M.P.

ANONYMOUS. "New Breeding Methods Produce Midget Mules." *Popular Science Monthly* 134: 122–123; May, 1939.

Lex Watson of Columbia, Tennessee, by crossing a midget male donkey with shetland ponies, has produced midget adult mules about three feet tall and weighing 200 pounds.

—C.M.P.

DAVIS, HARRY M. "Winters Are Not What They Used To Be." *Science Digest* 5: 37–40; April, 1939.

Indications that winters are not as cold as they used to be, have been substantiated by comparing weather temperatures of past decades with more recent decades. Temperatures in the Arctic are definitely higher than formerly. This fits in with Professor Ellsworth Huntington's theory of climatic pulsations. Tree rings and traces left by

the rise and fall of lakes have also been studied, and seemingly they show climatic changes in the past.

—C.M.P.

Anderson, Paul L. "How To Judge Photographs." *American Photography* 33:6–21; January, 1939.

This is the concluding article on points to be taken into consideration in judging photographs. Values are specifically considered in this article. Objective expression of the basic idea and imagination are very important.

—C.M.P.

Cooper, Willis. "On Having an Objective." *The Camera* 58:81–83; February, 1939.

The author presents reasons why amateur photographers should have a specific purpose for each picture taken—not just a "hit and miss" process.

—C.M.P.

Nixon, J. Stanley. "For Results—Glycin." *The Camera* 58:84–86; February, 1939.

The author gives reasons why he uses glycin as a developer in photography. All who have not tried it will want to do so after reading this article. The formula is given.

—C.M.P.

Tess, Stanley N. "Money Making Ideas." *American Photography* 33:106–112; February, 1939.

Ideas that will sell pictures are listed and described in this article. Pictures that would have news value are often rejected because of the following reasons: underexposed, overexposed, insufficient news value, not colorful, blurred, and out of focus.

—C.M.P.

Dutton, Laurence. "How Photographs Are Reproduced." *American Photography* 33:81–89; February, 1939.

In general there are three printing processes: letter press or relief printing, offset lithography, and rotary gravure. Approximately 90 per cent of all printing at the present time is done by letter press. This process is described in this excellent article.

—C.M.P.

Benedict, H. C. "Original and Unique the P. and H. Process of Negative Development. That P. and H. Process is Here Again." *Camera Craft* 44:106–110, 149–157; March and April, 1939.

The writer writes enthusiastically about the P. and H. developing process he is using. He claims the following advantages: (1) greatly improved shadow detail, (2) improved high light detail, (3) increased film speed, (4) increased latitude of exposure, and (5) improved detail definition. The formula included as are several contrasting pictures which seem conclusive proof of the author's assertions.

—C.M.P.

Keppler, Victor. "How to Make A Color Shot." *Better Photography* 2:5–11; March, 1939.

This article describes the fundamentals of lighting, color, and composition as used in color photography.

—C.M.P.

Diamond, Sidney A. "High and Low Key Pictures." *Better Photography* 2:55–58; April, 1939.

The article defines "key," false and true key—and how to make proper key pictures.

—C.M.P.

Powell, Jack. "How To Print in Clouds." *Minicam* 2:46–53; April, 1939.

This article describes the techniques of adding clouds to any suitable picture by the simple masking method.

—C.M.P.

Haburton, Ralph. "Negative Faults." *Minicam* 2:44–45; April, 1939.

Ten common defects are illustrated and described: (1) reversal, (2) scum marks, (3) reticulation, (4) fog, (5) streaks, (6) scratches, (7) air bubbles, (8) water spots, (9) clear areas, and (10) stains.

—C.M.P.

Erith, John. "75 Per Cent of Negative Retouching is Out of Date." *American Photography* 33:280–287; April, 1939.

The newer method is shading, not stippling, and the time for retouching negatives has been greatly reduced. Hard lead is used for the shading. The newer method also results in an improvement in the quality of the finished work, and the number of re-sittings required will be greatly reduced.

—C.M.P.

Anderson, Paul L. "Superstition in Photography." *American Photography* 33:241–252; April, 1939.

Superstition seemingly controls many of the acts of both professional and amateur photographers. They do many things which have no experimental or scientific basis.

—C.M.P.

Pels, Herbert. "The Professional Touch." *American Photography* 33:266–272; April, 1939.

The author expresses amazement at the amount of specialized knowledge that amateurs have apparently acquired. Much of the work and many of the processes have been worked out on a mathematical basis. However the author believes that much practical experience under varying conditions is still the one best guarantee of success in photography.

—C.M.P.

DAVIS, HARRY M. "Jupiter's Satellites." *Science Digest* 5:17–21; March, 1939.

Among the most important astronomical discoveries of 1938 were those by Seth B. Nicholson of the tenth and eleventh moons of Jupiter. Nicholson discovered the ninth moon in 1914. Galileo discovered four moons of Jupiter in 1610. One of the two newly discovered moons, the eleventh, has a retrograde motion. Moons eight and nine also have a retrograde or "wrong way" motion. The motion of these three moons of Jupiter and that of one of Saturn's moons remain among the most puzzling problems in explaining the mechanics and origin of the solar system.

—C.M.P.

HERNE, HILDA. "The Discovery of Quinine." *Discovery* 2:152–155; March, 1939.

The author relates interesting stories about the discovery of quinine and it's early use.

—C.M.P.

DARLING, F. FRASER. "I Lived With Seals." *Discovery* 2:112–120; March, 1939.

This article accompanied by a series of excellent photographs, relates the author and his wife's experiences among the Atlantic grey seals on the less than half-a-square mile island of Rona in the North Atlantic.

—C.M.P.

HANSON, O. B. "Here Comes Television." *Scientific American* 160:207–209; 251–252; April, 1939.

Broadcasting of regular television programs to the metropolitan area of New York will start in April. Commercial receivers will be on the market, too. Television is bound to have profound effects on our social order. The availability of a limited micro-wave network along the eastern seaboard before the Presidential Inauguration of 1941 is a probability. For at least a decade, television will likely be confined to more or less isolated stations located in large centers of population. Distance is now limited to about 50 miles, although pictures have been received as far as 100 miles. Plays, vaudeville entertainments, news events will constitute the chief programs. Television is unlikely to offer serious competition with the movies.

—C.M.P.

ANONYMOUS. "Find 'Extinct' Fish Alive in South African Waters." *Science News Letter* 35:195; April, 1939.

A fish, about five feet long, dark blue in color with a metallic luster, big goggle eyes, with a primitive cartilaginous skeleton, was recently caught in a net off the east coast of South Africa. Imagine the surprise of scientists—this fish was supposed to have disappeared 50,000,000 years ago. It is very much as if someone discovered a living dinosaur. This family of fish originated in the Devonian Age, 300,000,000 years ago and most of them were gone even before the Mesozoic. We will be hearing more about this fish!

—C.M.P.

EIFERT, VIRGINIA S. "The Story of Fire." *Natural History* 43:103–111; February, 1939.

Many legends of which the theft of fire from heaven by Prometheus is typical, show a widespread belief in the divine origin of fire. The author presents an interesting, fascinating story of the influence of fire on man's march from caves to skyscrapers.

—C.M.P.

INGALLS, ALBERT G. "Fire-Walking." *Scientific American* 160:135–138, 173–178; March, 1939.

The spectacular feat of walking barefoot over highly heated stones or white-hot embers (at temperatures up to 1400 degrees centigrade) without damage to the skin or flesh, practiced in India and Polynesia, has been surrounded with superstition and mystery. Scientists have recently investigated fire-walking and the secret seems to be solved. A few scientists have successfully completed the feat. Conclusions are: the fire-walk is in no sense a trick; the walk is performed in the normal manner with bare and chemically unprepared feet. Steadiness in walking is an advantage in order to avoid remaining with the weight on one foot too long. Moisture on the feet is a disadvantage. Fasting or initial preparation is unnecesary, as is any callosity of the feet. The real secret is brief contact, few contacts, and poor heat conduction.

—C.M.P.

CURRAN, C. H. "On Eating Insects." *Natural History* 43:84–89; February, 1939.

You and I eat insects, unknowingly, almost everyday—in lettuce, spinach, berries, olives, rice, bread, fruit, and so on. But then insects have nourished mankind for countless centuries without ill effect and are still openly relished in many parts of the world. As someone has said "what you eat and do not know, may not hurt you"—and this article points out many things we eat that we do not at all suspect!

—C.M.P.

New Publications

CURTIS, FRANCIS D. *Third Digest of Investigations in the Teaching of Science.* Philadelphia: P. Blakiston's Son and Company, Inc., 1939. 419 p. $3.50.

The accolade of honor for meritorious service in promoting professional advancement in the teaching of science in 1938 should be accorded to Francis D. Curtis. He richly deserves the honor because of this Third Digest. The first volume appeared in 1926 and the second in 1931. This Third Digest includes chiefly the research investigations published from 1931 through 1937. The content of this volume, as in the second, was selected by members of the National Association for Research in Science Teaching. There are digests of 94 studies included in this volume, together with supplementary lists of other studies.

The following differences between the content of this volume and of the preceding two, are indicative of trends in research in science education: (1) a greatly increased proportion of learning studies, (2) marked progress in the improvement and refinement of statistical procedures, (3) increased attention to problems dealing with the chief objectives of science teaching (scientific principles, scientific attitudes, and scientific method) and (4) increased proportion of investigations dealing with problems which are of general importance to the entire field of science teaching rather than of specific application to a single course.

As in the preceding volumes each research digested is analyzed as to problem, method, findings, and conclusion. Each study is indexed by author and by content.

All science teachers, supervisors of science, science curriculum workers, and administrators considering themselves up-to-date and progressive will own or have access to this book. To them it is indispensable. For courses in investigations in science teaching and science seminars, it is *the* book. —C.M.P.

CURTIS, FRANCIS D. *Investigations of Vocabulary in Textbooks of Science for Secondary Schools.* Boston: Ginn and Company, 1938. 127 p. $1.40.

This study summarizes and combines the results of 100 vocabulary studies and is the outcome of seven years of work by the author. Fifty-five of the studies represent Master's theses carried on under the author's direction at the University of Michigan.

After a discussion of the importance of vocabulary studies, the author describes an underlining test technique for determining whether pupils understand the meaning of the words they read. Results of these tests given to pupils in junior and senior high schools in general science, biology, and chemistry courses are analyzed—both for technical and nontechnical vocabulary—and used for surveys and recommendations with regard to terms used in textbook reading matter and glossaries. In general, vocabularies, both technical and non-technical, used in science textbooks are found beyond the comprehension of pupils who are expected to read them and not enough systematic effort is made to increase desirable comprehension. The glossaries listed indicate terms which should receive special attention. —A.W.H.

LYNDE, C. J. *Science Experience with Inexpensive Equipment.* Scranton, Pa.: International Textbook Company, 1939. 258 p. $1.60.

This book, the second of a series, describes and explains two hundred science experiences. The first eighty-five require only home equipment and the last one hundred fifteen require additional but inexpensive equipment. Teachers who have seen and used the first book will look forward eagerly to the reading of this second book. There are experiments covering the following fields: baseball curves and the life; centrifugal force; other mechanical principles; gas; liquids; heat; water pressure; atmospheric pressure; siphons; air compressed and expanded; other gases; and liquids. Each experiment is illustrated with one or more sketches. Explanations are given for principles illustrated.

This volume is most highly recommended to elementary science, general science, and physics teachers who would like to have some simple, practical experiments with which to illustrate some of the theories and principles in science. The book makes a real contribution to the improvement of science teaching. —C.M.P.

KING, JOHN W. *Give Your Hair a Chance.* Cambridge, Mass.: The Bradner Publishing Company, 1939. 157 p. $2.00.

This is a book that should be of personal interest to each reader of this review. It is a practical manual for the care and preservation of the hair, seemingly based on much careful investigation. Following the practical suggestions given, those of us whose hair is thinning or greying needlessly, or those of us whose hair may eventually do one or the other, or both, may well prevent much needless worry, trouble or uncomfortableness.

Many interesting facts are brought out about the hair. Heredity would seem to be of considerably less importance than the reviewer has heretofore believed. The prevention, cause and cure of dandruff is interestingly discussed, as is also the use of hair treatments. Diet, health, rest are the major factors in maintaining healthy hair. To those spending considerable sums of

money in hair treatments this book may well prove to be the best, cheapest investment ever made. —C.M.P.

BEAUCHAMP, WILBUR L., MAYFIELD, JOHN C. AND WEST, JOE YOUNG. *Science Problems, Book II.* Chicago: Scott, Foresman and Company, 1939. 578 p. $1.48.

A review of Book I appeared in the November, 1938 issue of *Science Education.* This second volume follows the organization of the first volume, consisting of an introductory photograph, introducing exercises, a "looking ahead" overview, a series of problems to be developed, a set of self-testing exercises, a series of problems to solve, and additional exercises.

This book carries out the cumulative approach. Where principles developed in Book I are necessary for solving problems in Book II, attention of the student is called to this by means of an asterisk. In the back there are lists of recommended readings for each unit and a complete pronunciation and science word-meanings glossary. Modern type and numerous up-to-date teaching pictures add much to the unusual attractiveness of the book.

The eleven units are: (1) What is the relation of the earth to other heavenly bodies? (2) How is the force of gravity useful to us? (3) How does the earth's surface change? (4) Why do some things rise and others sink in fluids? (5) How do we use energy? (6) How do we control heat? (7) What makes the weather change? (8) How do our bodies work? (9) How can you help your body fight disease? (10) How does life continue on earth? (11) How does man take care of the plants and animals he uses? —C.M.P.

BUSH, GEORGE L., DICKIE, ALLAN, AND RUNKLE, RONALD C. *A Biology of Familiar Things.* New York: American Book Company, 1939. 695 p. $1.92.

Quoting from the preface: *A Biology of Familiar Things* is a pioneer text made to bring biology within the easy comprehension of the great body of high school boys and girls who are eager to have an interpretation of the everyday life about them. With this end in view, the chief emphasis of this book has been placed on those living forms which are of greatest interest to young people. (Reviewer's note: No evidence is presented or cited to show that the authors actually used any experimental data in arriving at this finding.) Individual and community health, the care of pets, the cultivation of flowers, the control of pests, and the conservation of natural resources—these are some of the topics considered worthy of treatment. Through the treatment of such topics the various biological principles are carefully developed, and the applications of these principles made clear to the student. The method of presentation permits the elimination of much uninteresting technical material commonly found in more conventional texts. An effort has been made to keep the style as simple and informal as possible, and free use has been made of pictures. Although this book has been written with the needs of the average student always in mind, the exceptional individual has not been overlooked.

The authors have seemingly accomplished the tasks they set and are to be most highly commended for a really pioneer textbook in biology. It is the kind of book that deserves the widest usuage possible—the type of book that we need in general science, physics and chemistry as well. We hope the authors have really started a new fad in biology texts. A wideawake biology teacher will find sufficient laboratory works suitable to accompany the textual material. It is assumed that the authors have such a laboratory manual in preparation.

The picures are pertinent, appealing. The style is informal, and most readable. Written in the usual unit method, the units are as follows: (1) "What Is Biology?," (2) "Man in Good Health," (3) "Man and Disease," (4) "Plants for Beauty and Enjoyment," (5) "Biology in the Production of Food and Clothing," (6) "Pets for Pleasure and Profit," (7) "Pests in and About the House," (8) "Biology in the Conservation of Soil and Water," (9) "Conservation of Living Things," and (10) "Biology of the Future." —C.M.P.

HESSLER, JOHN C. AND SHOUDY, HENRY C. *Understanding Our Environment.* Chicago: Benj. H. Sanborn and Company, 1939. 661 p.

This is a general science textbook organized in the commonly accepted unit form. There are 19 units each subdivided into three to eight problems. Units are as follows: (1) "How Does the Earth Fit Into the Universe?" (2) "What Is the Importance of Air?" (3) "In What Ways Is Water Useful?" (4) "Why Is Heat Important to Man?" (5) "How Are Weather and Climate Important?" (6) "Is the Surface of the Earth Always the Same?" (7) "How Are Our Buildings Constructed?" (8) "How Are We Clothed?" (9) "How Do Plants Live?" (10) "How Do We Depend on Animals?" (11) "What Species of Plants and Animals Are too Small for Us to See?" (12) "Why Must We Have Food?" (13) "What Uses Do We Make of Light?" (14) "What Do We Need to Know About Electricity?" (15) "How Do We Communicate?" (16) "How Do Machines Enable More to Do More Work?" (17) "What Transportation and Communication Systems Exist Within the Body?" (18) "How Can We Maintain Good Health?" and (19) "How Can We Use Our Natural Resources to Best Advantage?"

The senior author is president of James Millikin University and the junior author a teacher of science in the North High School of Syracuse, New York.

Each unit has a very brief preview, a list of preview questions, laboratory experiments, tests

for the unit, questions and a list of selected readings.

The lists of selected readings are not as complete as they might have been and no careful distinction has been made between those strictly for the teacher and those for pupils. The style of the book is not as appealing to junior-high-school pupils as it might be. It is definitely *"textbooky,"* but in this characteristic it resembles altogether too many general science texts. The topics selected for units seem to be very good. It would seem to be definitely a ninth-grade book. A wealth of information is included and students using this as a basal text will have a broad background of scientific information and experience. —C.M.P.

BUSH, GEORGE L., PTACEK, THEODORE W. AND KOVATS, JOHN, JR. *Safety for Myself and Others.* New York: American Book Company, 1937. 127 p. $.44 (paper cover).

This is a unit of work in safety which originally appeared as the final chapter in *Senior Science* and in *Guided Activities in Senior Science* written by the same authors. It includes suggestions for study of safety in home, school, out-of-doors, industry, and safe city and country driving. It contains a discussion of various types of accidents together with study exercises for children, suggestions for class discussions, individual assignments, and research. It is well and abundantly illustrated by photographs and line drawings.

This unit on safety is appropriate for use by pupils in junior and senior high schools.

—F.G.B.

GUSTAFSON, A. F., RIES, H., GUISE, C. H. AND HAMILTON, JR., W. J. *Conservation in the United States.* Ithaca: Comstock Publishing Company, 1939. 445 p. $3.00.

The United States is for the first time, becoming "conservation conscious." And everyone the least bit interested in conservation agrees it is about time, if we are to recuperate some of our losses or even to retain our present natural resources. Conservation courses are now being taught in a number of institutions. This volume is intended to be a non-technical presentation for the purpose of acquainting students and other interested readers with important facts concerning the conservation of natural resources of the United States. A broad and inclusive plan for conserving and restoring our natural resources will be adopted only when it is demanded and supported by a public that is well informed on the subject of conservation.

The authors of this treatise are professors at Cornell University. The four parts of the book are: (1) Conservation of Soil and Water Resources, (2) Conservation of Forests, Parks and Grazing Lands, (3) Conservation of Wild Life, and (4) Conservation of Mineral Resources.

There are numerous photographs, graphs and a list of supplementary readings. —C.M.P.

GRAY, CAROLYN E. AND STACKPOLE, CAROLINE E. *Study Guide Test-book in Anatomy and Physiology.* New York: The Macmillan Company, 1939. 105 p. $1.00.

The main purposes of this book are to serve as a study guide for students, in the preparation of lessons, and as a test-book for teachers in conducting written quizzes. Each exercise is a unit in itself and may be used in any order to suit the teacher's convenience.

The use of such a book as this should do much to clarify the subject matter for the student and also add much interest to the course. It should help to give the student a more satisfying sense of mastery over rather difficult subject matter.

—C.M.P.

ALEXANDER, WILLIAM P. AND CORMACK, MARIBELLE. *Bruce and Marcia, Woodsmen.* New York: American Book Company, 1939. 221 p. $.80.

This is the story of the experience of two children who with a friendly elderly gentleman and naturalist take exploratory trips into fields, woods, and meadows. On their fortnightly excursions, they have many thrilling experiences and much pleasure in learning secrets of animals and plants that are waiting for boys and girls to discover them. After each trip, the happy children and their companion return home with many treasures, such as seeds, fish, spiders, shells, rocks, fossils, winter twigs, and deserted homes of animals.

The story is told in a fresh stimulating style that is likely to fill any boy or girl with a desire to form a club for young naturalists and to explore the fields and woods as Bruce and Marcia have done. The book is abundantly and beautifully illustrated by line drawings. Children from eight to ten years of age or even older will be delighted with the book. —F.G.B.

ALLEN, SHIRLEY W. *An Introduction to American Forestry.* New York: McGraw-Hill Book Company, Inc., 1938. 402 p. $3.50.

A comprehensive treatment of forests as a textbook for beginning classes in forestry, or as a reference on forestry for high school and college biology classes. The economic and social values of forests are emphasized. The development of forests, practices in forestry, forest protection, policy and administration by all groups are included. The book is clear, readable, and interesting. It is illustrated by photographs and drawings. A list of literature cited "and other sources" is given at the end of each chapter.

—L. M. Shoemaker.

GLOVER, KATHERINE. *America Begins Again.* New York: McGraw-Hill Book Company, 1939. 382 p. $1.76.

This is one of the most timely books that has been published in some time to meet the need of usable, authoritative material in the field of conservation. This field is rather barren in teach-

ing materials at the present time—for the conservation movement which is sweeping over this country is relatively recent. Science and conservation afford a rich field for integration and correlation.

Various phases of conservation are discussed: soil, water, forests, minerals, power, men, and wild life. There is a foreward by Stuart Chase, and a usuable bibliography. Yes, "America Begins Again" the conquest of waste of our natural resources—and the best place would seem to be with the youth in American classrooms.

—C.M.P.

GILBERT, MARGARET SHEA. *Biography of the Unborn.* Baltimore: The Williams and Wilkins Company, 1938. 132 p. $1.75.

This is a detailed and fascinating description of the first nine months of life of the human being from the moment of conception to birth. It is a prize award manuscript, written by a young embryologist who had just had her first baby. Simple illustrations make the text clearer. It is an excellent book for use by the layman and by the student of biology.

—L. M. Shoemaker.

HENDERSON, YANDELL. *Adventures in Respiration. Modes of Asphyxiation and Methods of Resuscitation.* Baltimore: The Williams and Wilkins Company, 1938. 316 p. $3.00.

The author tells in a clear, straightforward manner the facts of respiration which forms the basis of resuscitation from asphyxia as he has experienced them. Much of this story is the recounting of explorations in a new phase of the problem. He discusses topics, such as oxygen and carbon dioxide; shock and acapnia; the fallacy of asphyxial acidosis; the control of breathing and blood alkali; mountain sickness and acclimatization; carbon monoxide asphyxia and resuscitation; gases of peace and war; breathing, asphyxia, and resuscitation of the newborn; postoperative depression; asphyxia by failure of the circulation; and muscle tone as a factor in artificial respiration.

This is a valuable book for lay readers and those interested in the study of respiration.

—F.G.B.

BEUTNER, R. *Life's Beginning on the Earth.* Baltimore: The Williams and Wilkins Company, 1938. 222 p. $3.00.

In this book the author has attempted to present all facts pertaining to the origin of life, a question that is of interest to everyone and of fundamental importance in scientific development. He gives a clear, concise presentation of facts relating to the topic. He first discusses the "Evolution of life on the earth," and then considers the "vital growth and crystallization" as one approach to the subject. This is followed by a second approach, "Life, carbon's outstanding property."

This is a clear presentation of a point of view that indicates possibilities that the answer to the origin of life lies in the field of chemistry. This point of view may open up a way for answering a problem that is of vital importance to everyone.

—F.G.B.

COLLINGWOOD, G. H. *Knowing Your Trees.* Washington, D. C.: The American Forestry Association, 1937.

This consists of accurate and detailed descriptions of 50 native and adopted trees which have appeared in *American Forests.* Two pages of print, page size 8½ x 11½, give the appearance of each tree, its uses and economic importance, meaning of its scientific name, habitat, history, enemies. The large page size allows for photographs of habit of growth of leaves, fruit, bark, sometimes of blossoms.

This book meets the needs of grade school pupils, of high school pupils, of the layman, and of the botanist and forester.

—L. M. Shoemaker.

HYLANDER, CLARENCE J. *The World of Plant Life.* New York: The Macmillan Company, 1939. 722 p. $7.50.

This is probably the most comprehensive book on plants that has yet been written for the general reader. The author has done for plants what Hegner did for animals in "Parade of the Living." Each book is really a classic.

Virtually every common type of plant now existent in this country, native and naturalized, is classified and discussed as to distribution, habits, uses, and the various unique and specialized structures which enable them to live in specific environments.

The author is assistant professor of botany at Colgate University. In gathering material for this volume the author traveled twice by car and trailer from Maine to California. The book contains over 400 excellent photographs and line drawings which add much to the usefulness and attractiveness of the book.

This book is truly a survey of the plant kingdom. With its wealth of information it is especially recommended as a reference book for the high-school and for survey courses in college. All science teachers and general readers will find this book a most valuable reference and source of information on plants. Altogether the book constitutes one of the finest books ever published on plants.

—C.M.P.

DANTZIG, TOBIAS. *Number, The Language of Science.* New York: The Macmillan Company, 1939. 320 p. $3.00.

This is the third edition, revised and augmented, of a book first published in 1930. In this book the author attempts the task of telling the story of the evolution of mathematical thought to the mathematically untrained but intelligent layman—a sort of a first attempt at the popularization of mathematics. This third edition affirms the success of this attempt. This edition includes

more history, more philosophical discussion, and more amplification of certain technical points.

—C.M.P.

MENZEL, DONALD H. *Stars and Planets. Exploring the Universe.* New York: The University Society, 1938. 129 p. $.65 paper cover. $1.00 cloth cover.

This book is one of *The University Series* entitled *High Lights of Modern Science.* The purpose of this series is to present in attractive form and in concise, readable style, the truly amazing story of the life of mankind—an authoritative survey of the physical and social sciences, biology, philosophy, literature, and the arts. In this book the author presents the essential facts of ancient and modern astronomy. He introduces the reader to the vastness of space, to the tools used by astronomers, to the sun with its planets and their satellites, to comets, meteors, eclipses, stars, constellations, and to the origin of the solar system.

This is the third edition of a book that has had wide use in college classes. The revision was necessitated by the rapid development of astronomy during the past few years. The book is well illustrated by photographs, diagrams, and star maps. Lay readers and students will find it a valuable survey of a fascinating subject.

Accompanying *Stars and Planets* is an *Exploratory Reading Outline* designed to assist the reader in using the book and to give suggestions for supplementary study. The outline sells for five cents. —F.G.B.

DRAPER, ARTHUR L. AND LOCKWOOD, MARION. *The Story of Astronomy.* New York: The Dial Press, 1939. 394 p. $3.00.

This story of astronomy is one of the most readable treatises that has been published. It is especially suitable for the secondary-school student and for the layman and is an excellent addition to the secondary-school library. The treatment is authoritative and written in fascinating, readable style. The authors are two of the leading authorities at the Hayden Planetarium in New York Ctiy. The story of astronomy is traced from its earliest beginnings to the latest and most startling discoveries. The treatment is especially well-balanced as to the discussion on the various phases of astronomy. There are many excellent photographs which add much to the attractiveness of the book.

—C.M.P.

BENNETT, H. (Editor-in-Chief). *The Chemical Formulary.* New York: Chemical Publishing Company of New York, Inc., 1939. 638 p. $6.00.

This new 1939 edition of *The Chemical Formulary* is a gold mine of fascinating, useful information on formulae and practical methods for making thousands of products used everywhere. Each formula gives not only the ingredients and quantities of each to use, but explains the steps in the production of the finished material. Students in the reviewer's classes have had uniformly successful results in making several of the materials listed and the products made were seemingly equally good as similar products of well-known trade names, costing many times the cost of the raw materials used. To put new life in old chemistry, allow your chemistry students to made some of the products described in this book. Results and new interest in chemistry may surprise the instructor.

The formulas are those used in commercial concerns and have been collected through the efforts of a board of editors of outstanding chemists. You can make your own tooth pastes, face powder, soap, cold creams, etc., successfully and very cheaply by using formulae in this book. The reviewer recommends this book unhesitatingly to the chemistry teacher and for the secondary science library. They could not have a more useful, practical supplementary book. —C.M.P.

NELSON, EUGENE W. *The Magic Wand of Science.* New York: E. P. Dutton and Company, Inc., 1938. 213 p. $2.00.

The author's purpose in writing this book is to help young people "have a better understanding of our scientific age, of the men who have made it possible, and of how some of our most valuable scientific tools have evolved." The book is full of explanations of phases of science and invention, such as the microscope, thermometer, enzymes, wealth of the sea, eighteen kinds of water, farming on water, putting "dry ice" to work, raincoats from test tubes, new light in lightning, and our enemy, noise.

The book is written in a clear, attractive, and entertaining manner. Appropriate illustrations in the form of drawings and photographs form an integral part. *The Magic Wand of Science* will be enjoyed by young people and lay readers. It should be available in the libraries of junior and senior high schools and in public libraries.

—F.G.B.

KANDEL, I. A., Editor. *Educational Yearbook of the International Institute of Teachers College, Columbia University.* New York: Bureau of Publications, Teachers College, Columbia University, 1938. 399 p.

This yearbook is devoted exclusively to the problems of rural education and the conditions which are directly related to it in fourteen countries of the world: Argentine Republic, Australia, Brazil, Canada, China, Czechoslovakia, Denmark, England, France, Germany, India, Mexico, Norway, and the United States.

Each article is complete in itself and contributed by some one who has been intimately concerned with rural education in the country involved. In the introduction by the editor and throughout the various discussions, there is constant reiteration of the necessity of a close tie-up between the schools and the environment of which they are parts. Therefore, there is distinct

emphasis upon the nature of the rural environments in the several countries. Topics generally considered are varieties of rural populations; rural conditions; school populations; school attendance; teacher personnel, preparation, certification, organization, and the like; school curricula; vocational education; the school plant; consolidation; school administration; school costs; and varied specialized features.

The book is a real contribution to educators everywhere, not only to those interested in rural education. The vitality of life in any country is intimately bound up with the education of those who live in it and national welfare ultimately depends in considerable degree upon the efficient education of those in rural as well as those in urban sections.

In these accounts, one may get a brief overview of a large part of the world of people as a whole and glimpse the final need for, and possibilities of, an integrated consideration and unification of human life in all nations. —A.W.H.

THE DEPARTMENT OF SUPERVISORS AND DIRECTORS OF INSTRUCTION OF THE NATIONAL EDUCATION ASSOCIATION. *Cooperation, Principles and Practices, Eleventh Yearbook.* Washington: National Educational Association, 1938. 244 p.

It is noteworthy but strictly in keeping with the logic of human events that a whole book on cooperation as a policy in public school practice should be prepared and published by a yearbook committee. Part I considers principles of cooperation; Part II, Practices.

Cooperation as a philosophical and psychological concept is discussed in the first four chapters; as an educational, democratic, and administrative concept in the succeeding three chapters; and as an ideal in the last two chapters of Part I.

Experimentation and questionnaire studies are reported in Part II. They indicate promising steps in attempts to establish cooperative programs involving pupils, instructors, and administration but ample room for improvement toward democratization. Administrators seem to doubt ability of teachers to carry on administrative functions although teachers are more confident that they have these abilities.

Such studies will undoubtedly define more clearly the nature of democratic procedures and the place of cooperation in such a program.

—A.W.H.

HASKINS, CARYL P. *Of Ants and Men.* New York: Prentice-Hall, Inc., 1939. 244 p. $2.75.

Ants are found everywhere—in backyards, around plants, under sidewalks, logs, and stones —and are widely distributed over the world in jungles, forests, mountains, and plains. They are among the most abundant insects. In a most fascinating manner, the author, a student of ants, traces the evolutionary development of these common insects through long ages dating from the Mesozoic era. During this period ants have become greatly diversified and widely spread over the earth. He points out "the striking and conspicuous parallel in the social evolution of ants and men to the likenesses and the dissimilarities which characterize modern ants and men as individuals—the end products of this long race growth."

The author has done a remarkable piece of work in pointing out to the reader the ways in which ant societies operate, the social problems they have faced and how they have solved them, and how they have worked out their problems relating to warfare, reproduction, food and society. The reader is stimulated to want to study ants as a hobby for as the author states there is seldom a spot which does not harbor at least one colony. In closing he says that "no species of ant is so common that careful examination of its nest habitat may not reveal some condition, social or biological, which is entirely new —not only to the experience of the observer but to the experience of humanity as well."

The book is beautifully and appropriately illustrated by fifteen full page photographs. It is a Scientific Book Club selection for 1939. Teachers and scientific workers in the field of biology as well as laymen interested in their natural environment cannot afford to miss reading this book. F.G.B.

ALLEN, PAUL WILLIAM. *The Story of Microbes.* St. Louis, Mo.: John S. Swift Company, Inc., 1938. 454 p. $3.00.

There is a time in the life of every individual when some information about microbes is gained through first hand experiences. A more extended knowledge among people would undoubtedly save much suffering and loss of life as well as loss in time and money. To help orient the layman in becoming better informed regarding microbes and their relation to living, this book was written. It serves equally as well in orienting the young student in microbiology as a profession. The author tells in a simple, dignified and delightfully interesting manner the story of the development of the microscope by Leeuwenhoek and the great contributions to microbiology by men, such as Jenner, Pasteur, Lister, Hansen, Ehrlich, Trudeau, Metchnikoff, and Burrill. He traces the development of knowledge regarding diseases, such as typhoid fever, diphtheria, pneumonia, measles, influenza, dysenteries, common colds, infantile paralysis, lock-jaw, rabies, and Asiatic cholera. The book is well illustrated by many woodcuts, photographs and line drawings.

This is the second edition of a valuable book. The first edition was published in 1932.

—F.G.B.

LOW, A. M. *Science for the Home.* New York: Thomas Nelson and Sons, 1938. 215 p.

The author attempts to show that science plays a vital part in the manufacture of many articles of the home, in the building of our houses, the disposal of rubbish, and the purification of the public water supply. For the American reader,

the phraseology of this popularized science volume is interesting. The chapter Gramophones, Wireless and Television would be called Phonographs, Radio and Television in America. An explanation is made of the "valve" of the wireless, which is our radio tube. There are several other expressions which are different from those in general use in America.

Some of the subjects discussed in this book are clocks and time, washing and shaving, chemicals in the kitchen, carpets and linoleum, plastic and other new materials, and electrical appliances. Each of the eighteen chapters includes at least one full page illustration.

—Roy V. Maneval.

BEADNELL, C. M. *Dictionary of Scientific Terms.* New York: The Chemical Publishing Company, Inc., 1939. 235 p. $3.00.

The English author of this dictionary has compiled his list of words from notations taken from recently published scientific books and from articles in science periodicals. It is a comprehensive list, including such terms as heavy hydrogen and heavy water. It would be a valuable reference book in any science library.

—Roy V. Maneval.

PARKINS, E. E., AND WHITAKER, J. R. *Our Natural Resources and Their Conservation.* New York: John Wiley and Sons, 1939. 647 p. $4.00.

This volume surveys our national resources namely: land, soil, trees, forests, water supply and power, mineral ores, fuels, wild life, fisheries, and man. Some attention is given to conservation of arid regions and to reclamation of wet lands. The development of the conservation movement is sketched and a bit of the historical setting is given for each resource.

The 24 chapters have different authors but in this second edition the editors have made cross references and removed duplication that was present in the old edition. The treatment is comprehensive and brings information up to the present. There are half-tone and line-cut illustrations, diagrams, and maps. —W.G.W.

TAYLOR, F. SHERWOOD. *The March of Mind.* New York: The Macmillan Company, 1931. 320 p. $3.00.

The scientist is openminded. He is constantly changing his views as new evidence is presented. This book is a short history of science and covers "The Beginnings of Science," "The Science of Greece," "Eastern and Arabic Science," "Mediaeval Science," "Science in the Renaissance," "The Rise of Modern Science," and "The Age of Science." It contains 14 full-page plate illustrations and 36 drawings. The story of man's beliefs and changes in man's thinking throughout the centuries of progress is interestingly told. There are many rare illustrations. —W.G.W.

MELHUS, IRVING E., AND KENT, GEORGE C. *Elements of Plant Pathology.* New York: The Macmillan Company, 1939. 493 p. $4.00.

We well know that man is attacked by many diseases but few realize the multitude that attack plants. No less than forty diseases are known of the apple. Not only do our food plants have to resist insects but they have to resist disease. Much of the cost of food production may be debited to man's efforts to protect plants from their enemies. *Elements of Plant Pathology* investigates in detailed fashion the ontologies of the chief disease producing organisms which attack our food plants. In each case the etiology and symptomatology are described and the control is indicated. Halftone pictures show disease conditions, diagrams illustrate the cycle of life and detailed drawings help to reveal how the disease works after infection. The book offers students an unusual wealth of practical information. The emphasis is upon parasitism and the diseases have been grouped in divisions as: phycomycetes, bacteria, ascomycetes, basidiomycetes, virus-diseases, nematodes and non-parasitic agents.

—W.G.W.

CHAPMAN, FRANK M. "Life in an Air Castle." New York: D. Appleton–Century Company. 1938. 250 p. $3.00.

When Gatun Lake was made by damming the Chagres River in the Canal Zone, an island was left including almost four thousand acres. This forested island, known as Barro Colorado, ranges from water level to 452 feet above water, thus offering quite a variety of conditions for plant and animal life. Dr. Chapman has studied bird life on this island for part of a dozen years. One of his books, "My Tropical Air Castle," discussed his island home and his observations about it. The present volume is a sequel to that earlier publication and includes quite as much non-bird as avian studies.

The author had need of a personally propelled water transport, but row boats were not available. Anyway, the natives insisted their "cayuca" was superior, so one was made. A large tree was felled, the outside of the boat formed, and the inside hollowed out, before the boat was chopped off from the rest of the tree. Then the boat was cut off, polished and placed in water. Such a readily capsizable transport required full cooperation from its owner, penalty for momentary failure being the task of retrieving oneself from the uninviting water. But properly used, such a boat permitted the observer to push noiselessly among overhanging bushes or to lie still and watch birds or other animals.

Dr. Chapman's method of working has always been to focus his whole attention for a period on one particular problem, not usually allowing himself to be pulled away from his purpose. Thus, as here recounted he studies buzzards for a long time trying to settle the old question

whether they find their food by sight or by smell. He concludes as he announced once before that the buzzard depends "for its existence on its powers of flight and discriminating use of its senses of sight and smell." The writer studied the mating behavior of Gould's manakin, a rare tropical bird, little known even to those who have travelled the tropics. Each one of the strikingly colored male birds prepares a miniature clearing as a dancing or courting spot on the forest floor. On these "floors" or "courts" each male performs gyrations hoping to win the favor of the sombre-colored female. The elusive nest made wholly by the female in which she lays two eggs, is at no time a matter of interest to the male. All the work of building, care and rearing the young are wholly ignored by him.

The book includes most interesting observations and conclusions about wild hogs, monkeys, the tapir, puma, and other little known animals. The care in observation and the distinctive style of Chapman make this a valuable addition to engaging reading-books about tropical studies.

—Otis W. Caldwell.

ZINSSER, HANS. *Rats, Lice and History.* New York: Blue Ribbon Books, Inc., 1938. 301 p. $0.98.

An eminent bacteriologist takes up his role as a biographer with the result that an extraordinary story has been written about typhus fever. This unusual and charmingly written book is about a disease that through epidemics has had enormous influence on the history of the world. The author states that even as recently as the World War the outbreak of typus fever in Serbia made the the country almost helpless in the face of its enemy. Although almost helpless for months, Austria did not attack. Obviously typhus was holding the border. Austria chose not to send its army into the arms of almost certain death from this dreaded disease. Had this not been true, history might have taken a different course.

This story was written for the amusement and pleasure of the author and as a relaxation from his serious laboratory and field studies of typhus fever. His wide acquaintance with literature is indicated by many comments of literary interest which the reader enjoys thoroughly.

This book will be of interest to all who enjoy witty, charming discussions and by those interested in typhus fever. Since this outstanding book is now published by the Blue Ribbon Books, Inc., it is possible to purchase it at a low price.

—F.G.B.

DYSON, FRANK AND WOOLLEY, R. V. D. R. *Eclipses of the Sun and Moon.* New York: Oxford University Press, 1937. 158 p. $5.00.

"—the main theme of this book is the solar eclipse as an instrument for the study of the physical state of matter in the outer layers of the sun. The instruments in use on eclipse expeditions and the type of observations made are described and the general nature of the physical information as yet won from eclipses is discussed. Many of the gaps in our knowledge are pointed out." The treatment is rather technical, requiring a good background of physics, astronomy and mathematics.

—O. E. Underhill.

HODGMAN, CHARLES D. *Chemical Tables from the Handbook of Chemistry and Physics.* Cleveland: The Chemical Rubber Company, 1938. 1383 p. $6.00. (Student Edition $3.50.)

Much of the material is taken from the Handbook, but a great deal of new material has been added and considerable material has been extensively revised. This book or the Handbook is almost indispensable to the college chemistry teacher and it is recommended to every secondary chemistry teacher. Some of the topics include: (1) Antidotes of poisons; (2) Burns and scalds, (3) Fire precautions and chemical hazards, (4) Properties and physical constants, (5) General chemical tables, (6) Specific gravity and properties of matter, (7) Heat, (8) Hygrometric and barometric tables, (9) Light, (10) Electricity, (11) Quantities and units, (12) Laboratory arts and recipes (good), (13) Photographic formulae, (14) Plate and film speeds, and (15) Abbreviations.

BRIGGS, THOMAS H. *Improving Instruction.* New York: The Macmillan Company, 1938. 587 p. $2.50.

"This book," says Dr. Briggs, Professor of Education at Teachers College, "has grown out of a university course on the improvement of instruction in secondary schools that has been developing for twenty years. It is based on a conviction that supervision as defined and presented is the urgent need of every school and the supreme duty of every principal." While the book is of more value to the high school principal and various secondary supervisors, it can be read with equally great profit by all teachers. Chapter headings are as follows: (1) The meaning of supervision, (2) Types and means of supervision, (3) Teachers and supervision, (4) Organization for supervision, (5) The principal a responsible leader, (6) The principal's relations with orders, (7) Some principles of supervision, (8) Planning for supervision, (9) The ultimate basis of supervision, (10) The golden rules of education, (11) Purposes for teachers, (12) Purposes for pupils, (13) Classroom observations, (14) Supervisory conferences, (15) Teachers meetings, (16) Other means of supervision, (17) Measurement in supervision, (18) Supervisory experimentation, and (19) Evaluating supervision.

—C.M.P.